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**THE**  
**COMPLETE GRAZIER**







**Shorthorn Bull, "Royal Duke," 75,509.**

Bred by Her Majesty Queen Victoria, and subsequently owned by His Majesty the King, Champion Male of his Breed at three Shows of the Royal Agricultural Society of England.

THE  
**COMPLETE GRAZIER**  
AND  
FARMERS' AND CATTLE-BREEDERS' ASSISTANT  
FORMING  
A COMPENDIUM OF HUSBANDRY

ORIGINALLY WRITTEN

BY WILLIAM YOUATT

MEMBER OF COUNCIL OF THE ROYAL AGRICULTURAL SOCIETY OF ENGLAND

CONSIDERABLY ENLARGED AND MAINLY RE-WRITTEN IN 1893 AND 1900

BY WILLIAM FREEM, LL.D.

ASSISTANT COMMISSIONER, ROYAL COMMISSION ON AGRICULTURE, 1893

**Fifteenth Edition**

THOROUGHLY REVISED AND BROUGHT UP TO THE PRESENT REQUIREMENTS  
OF AGRICULTURAL PRACTICE

BY WILLIAM E. BEAR

FORMERLY EDITOR OF THE *MARK LANE EXPRESS*, AND AUTHOR OF "THE BRITISH FARMER  
AND HIS COMPETITORS," "A STUDY OF SMALL HOLDINGS," ETC.

With upwards of Four Hundred and Fifty Illustrations



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7 STATIONERS' HALL COURT, LUDGATE HILL, E.C.  
1908

Mr. Farr



# PREFACE

TO

## THE FIFTEENTH EDITION.

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[PUBLISHERS' NOTE.—When the lamented death of Dr. William Fream occurred in 1906, it appeared that he had not taken in hand the preparation of a new edition of this work to succeed the Fourteenth Edition issued in 1900; and the Publishers count it a fortunate circumstance that the preparation of the present edition has been undertaken by Mr. W. E. BEAR, himself a writer of high authority on Agricultural subjects, who was numbered amongst Dr. Fream's personal friends and professional associates.

As Youatt's COMPLETE GRAZIER, the earlier successive editions of the work had for several generations been universally accepted as a high standard authority, when in 1893 it was so thoroughly revised and reconstructed for the Thirteenth Edition under Dr. Fream's editorship, that thenceforward it became identified as much with the name of its new Editor, as with that of the Author of the original work; and as Youatt and Fream's COMPLETE GRAZIER it has since more than maintained its ancient high reputation.

For the Fourteenth Edition of 1900, such further revision as was necessary to incorporate new features in Agricultural practice which had established themselves in the intervening seven years was carried out under the supervision of Dr. Fream himself. The several respects

in which the volume has now been further revised and modified in Mr. BEAR'S hands, so as to bring it in all points fully up to date, and so that it may worthily maintain its position in the Agricultural world, are particularised in the succeeding Preface: and while recording their thanks to Mr. BEAR and those who have co-operated with him, the Publishers feel assured that, as thus revised, the COMPLETE GRAZIER will have a new lease of the great and world-wide favour which it has so long enjoyed, as presenting, in Dr. Fream's words, "a faithful mirror of progress and a reliable record of modern practice."]

THE last edition of THE COMPLETE GRAZIER, published in 1900, having become exhausted, it has been deemed desirable to revise the work thoroughly for the new edition now demanded.

The sections relating to the several classes of Live Stock, Dairy Farming, Poultry, Veterinary Science, Agricultural Chemistry, Statistics, and certain Farm Crops, have been greatly modified, and partly re-written, in order to bring them into line with present-day knowledge and practice. Knowledge has greatly advanced, and some farm practices have been considerably modified, since the close of the late Dr. Fream's labours in editing an enlarged and practically new "Youatt." More or less extensive alterations, therefore, have been made in all the above-named sections. On the other hand, the sections relating to Natural History, in which Dr. Fream was particularly pre-eminent, it was found might be left almost intact, as they appear to be in no need of substantial revision, and the present editor was reluctant to make any alterations not absolutely necessary in the admirable work of his predecessor.

As was to be expected from the manifold advances made in all mechanical matters in recent years, it appeared on investigation that many of the articles described and illustrated in the last edition, under the heads of Farm and Dairy Implements and Machinery, had passed out of date. While some have been superseded by new inventions, most of the rest have been improved in form and in detail. It was necessary, therefore, to re-write the Implement sections almost entirely, and to obtain fresh illustrations, for which thanks are tendered to the several firms named in those portions of the work.

With respect to illustrations of Live Stock, it has not been deemed desirable to displace well-executed and typical representatives of the several breeds simply on account of their being portraits of prize-winning animals of former years. On the contrary, while substituting, for what would now be unsatisfactory illustrations, those of champions at the latest show of the Royal Agricultural Society, it has been regarded as better to retain and give with them the portraits of many famous animals of the past, than to represent present-day animals exclusively. Amongst those retained are some which were supplied by Professor Wallace, who has kindly consented to their reappearance. The new frontispiece, which depicts one of the most perfect specimens of the Shorthorn breed of cattle ever bred, is referred to in the division of the work relating to that breed.

The valuable assistance of most of the specialists who were contributors to the last two editions has been enlisted for the

present one, though that of all was not available. Those who have co-operated in the revision include Dr. Bernard Dyer, Mr. A. T. Matthews, Professor J. Prince Sheldon, Mr. Sanders Spencer, Mr. Edward Brown, and Mr. A. H. Archer, M.R.C.V.S., to all of whom grateful acknowledgment is made. Mr. James Sinclair also is thanked for valuable information and advice.

W. E. B.

1908.

# PREFACE

TO

## THE THIRTEENTH EDITION.

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A TREATISE that made its original appearance in the first decade of the century, and that enters upon its Thirteenth Edition before the century has run its course, may be considered to have established its claim upon public favour.

In preparing this modernised and enlarged edition, therefore, it has been deemed expedient to retain, as far as possible, those features of Youatt's work which must have commended themselves to the general approval. Accordingly, very little alteration has been made in the scheme of the original volume, so that the treatise continues to be divided, as heretofore, into Books, and, saving that an additional Book has been introduced, the arrangement is the same as in the Twelfth Edition. To a considerable extent the sub-divisions of the several Books have likewise been retained.

It should be noted, however, that in giving to the various subjects the full treatment demanded in view of the phenomenal progress of the last dozen years, it has been found necessary to practically rewrite the work, and to enlarge it from some 900 to about 1100 pages. Entirely new chapters have been added on the Secretion of Milk (Book the Second), on the Anatomy

of the Horse (Book the Third), on Ensilage (Book the Ninth), and on the Natural Grasses (Book the Tenth).

The question presented itself for consideration as to how far it might be desirable to retain Book the Twelfth, in which are set forth Monthly Calendars of Farm Work in its various branches throughout the year. It was felt that, even within the limits of Great Britain itself, it would be difficult, owing to the differences in local conditions, to give for each month directions which would be everywhere applicable. On the other hand, it could not be forgotten that this series of calendars has always constituted a feature of *THE COMPLETE GRAZIER*, and it was accordingly decided to retain the Book in question. It has, however, been thoroughly revised by several competent practical authorities, and it is hoped that the various points which are recorded may serve at least as suggestions to the young grazier, though they can hardly be expected to fill any higher purpose than that of mere reminders to the experienced farmer.

With one or two exceptions the illustrations of Live Stock are new to the work. An endeavour has been made to present portraits of prize-winning animals of all the leading breeds, and a number of the cattle illustrated were selected because they were winners of Champion Prizes at the great Jubilee Show of the Royal Agricultural Society of England, held at Windsor in 1889. Representations of ideal animals have been excluded, but the observance of the rule of presenting only pictures from life has resulted in a certain degree of want of uniformity, since some of the portraits are reproduced from photographs, whilst others are wood engravings. Several of the illustrations are taken, by permission, from Professor Robert Wallace's well-known volume, "The Farm Live Stock of Great Britain."

In the other parts of the work the engravings which did duty

in the last edition have mostly been replaced by illustrations of more modern character. My special thanks are due to the Council of the Royal Agricultural Society for permission to reproduce various woodcuts which were originally published in the "Journal" of that Society.

The Frontispiece\* is a representation—produced in Vienna from a photograph kindly furnished by Mr. William Tait, of the Prince Consort's Shaw Farm, Windsor—of the Shorthorn bull, *New Year's Gift* (57,796). This bull, the birth of which took place on January 1st, 1888, was bred by Lord Lovat, of Beaufort Castle, N.B., from whom he was purchased by Her Majesty the Queen. After a most successful showyard career, in the course of which he won the male Shorthorn Championship at the Royal Agricultural Society's Meeting at Plymouth, in 1890, he was included in the sale of some of Her Majesty's cattle at Windsor, in March, 1892, and was knocked down to the Earl of Feversham at One Thousand Guineas, a figure which proved to be the top price of the year.

Within the period of a dozen years already referred to great changes have occurred. Many important Live Stock Societies have come into existence; the art of Dairying has been well nigh revolutionised; profound modifications have been made amongst the Mechanical Appliances of the Farm; and new processes, such as Ensilage, have become recognised parts of Agricultural Practice.

The day has gone by when one man could hope to deal successfully with the multifarious subjects which are brought under discussion in the present volume. Grateful acknowledgments are, therefore, made of cordial co-operation in the preparation of this edition, and particularly of valuable contributions from the pens of Professor J. Wortley Axe, Mr. Edward Brown, Dr. Bernard Dyer, Mr. W. J. Malden, Mr.

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\* Now appearing as a plate facing page 26 of the 1908 Edition.

R. Henry Rew, Professor J. P. Sheldon, Mr. James Sinclair, and Mr Sanders Spencer. Additional obligations are recorded in the text.

The proof-sheets of the entire work have been read by Mr. F. R. Armytage, M.A. (Balliol College, Oxford), Mr. A. E. Brooke-Hunt, B.A. (Trinity College, Cambridge), Mr. Malden, Professor Sheldon, and Mr. David Young, to all of whom my thanks are tendered. Other gentlemen have been good enough to examine the proof-sheets of parts of the treatise bearing upon subjects with which they possess special acquaintance.

It may be added that, throughout the volume, no effort has been lacking to make the text a faithful mirror of progress and a reliable record of modern practice.

W. F.

*January, 1893.*



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THE  
COMPLETE GRAZIER.

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BOOK THE FIRST.

ON THE VARIETIES, BREEDING, REARING, FATTENING, AND  
GENERAL MANAGEMENT OF CATTLE.

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CHAPTER I.

INTRODUCTORY VIEW OF THE DIFFERENT BREEDS OF CATTLE IN  
THE BRITISH ISLES.

OF all the various sources from which the wealth of nations is derived, there is not one that possesses a claim to attention superior to that branch of rural economy which forms the subject of the following pages. In fact, when we consider that not only the servants of a farmer, but his cattle also, are productive labourers; when we recollect the stimulus to industry, as well as the rapid circulation of capital, which the farmer occasions by furnishing constant employment both to his servants, and to the numerous artificers who are occupied in manufacturing the implements that are necessary to him; when we call to mind the immense mass of materials which his *productive* labour supplies for the purposes of commercial intercourse, and especially the influence exercised by that labour on the comfort and support of towns, whose inhabitants might otherwise be destitute of the necessaries of life;—when all these diversified circumstances are taken into consideration; every reflecting inquirer must acknowledge that, of all the methods in which capital can be employed, this is by far the most advantageous to society.

Justly, therefore, has it been remarked, “that the capital employed in agriculture not only puts into motion a greater quantity of productive labour than any equal capital employed in manufactures, but also, in proportion to the quantity of productive labour which it employs, it adds a much greater value to the annual produce of the land and labour of the country, while it increases the real wealth and revenue of its inhabitants.”<sup>1</sup>

<sup>1</sup> Smith's “Wealth of Nations,” 4th edit. vol. ii. p. 53.

Not less is it true that, in the words of a distinguished American orator and statesman,<sup>1</sup> "Agriculture feeds us: to a great degree it clothes us: without it we could not have manufactures, and we should not have commerce. These all stand together; but they stand together like pillars in a cluster, the largest in the centre—and that largest is Agriculture."

For a long time, many circumstances have co-operated to render live stock an object of the utmost importance to the farmer; and, notwithstanding the marked advances made in other branches of husbandry, nothing has undergone a greater change of system, and few things have received more manifest improvement, than the breeding, rearing, and management of cattle. It will therefore be advantageous to commence with a brief review of the principal breeds of cattle found in the United Kingdom.

WILD CATTLE—of a bull of which fig. 1 is a portrait—are still found in Chillingham Park, Northumberland, where they are allowed to roam



Fig. 1.—A Chillingham Bull.

at large in their primitive state. They are believed by some authorities to be the little modified descendants of the native Caledonian cattle which once roamed over the northern provinces of England and the southern parts of Scotland, and some of which had found their way to the mountains of Wales.

The following account of the Chillingham cattle is given by the Earl of Tankerville, and the late Mr. Bailey of Chillingham,<sup>2</sup> and, as it was written more than seventy years ago, it possesses an additional interest.

<sup>1</sup> Daniel Webster, at the first Country Meeting of the Royal Agricultural Society of England, at Oxford, 1839 ("Journal of the Royal Agricultural Society," vol. i., third series, 1890, p. 150).

<sup>2</sup> "Agricultural Survey of Northumberland," 3rd edit. p. 141, and "Proceedings of the British Association at Newcastle-upon-Tyne in 1838."

“Their colour is white, except that some of the bulls appear of a cream colour; the muzzle is black or brown; the whole of the inside of the ear, and about one-third of the outside, from the tip downwards, is red or brown, and the horns white with black tips, very fine, and bent upwards.<sup>1</sup> They have no manes, but some of the bulls have a little coarse hair on the neck, about an inch and a half or two inches in length. The weight of the oxen is from thirty-eight to forty-two stones of fourteen pounds; and that of the cows, from twenty-five to thirty-five stones the four quarters. The beef is finely marbled, and of excellent flavour.

“From the nature of their pasture, and the frequent agitation into which they are thrown by the curiosity of strangers, it cannot be expected that they should accumulate much fat; yet the six-years’ old oxen generally become exceedingly good beef. One of them was caught, and became as tame as the domestic ox, and throve as well as any short-horned steer could do. He weighed about sixty-five stones.

“At the first appearance of any person they set off at a trot, and gradually increasing their speed, gallop to a considerable distance; they then wheel round, and come boldly up again, tossing their heads in a menacing way. On a sudden they make a full stop, at the distance of forty or fifty yards, looking shyly at the object of their fear; but on the least motion being made, they again turn round, and set off with still greater speed. Forming, however, a shorter circle, and returning with a bolder and more threatening aspect, they approach considerably nearer. This they practise several times, shortening their distance, and advancing still nearer until they come within a few yards, when most people think it prudent to leave them. They feed mostly in the night, basking or sleeping during the day. In summer several successive weeks will pass with scarcely a possibility of seeing them, for at the appearance of anyone, even at the greatest distance, they retire into the wood, or behind some rising ground, and so screen themselves from view. On the other hand, when in winter coming down for food into the inner parts, they suffer almost anyone to come among them.

“The mode of destroying them is, perhaps, the only modern relic of the grandeur of ancient hunting. On notice being given that a wild bull will be killed on a certain day, the inhabitants of the neighbourhood come in great numbers, both horse and foot. The horsemen drive the bull from the rest of the herd until he stands at bay, when a marksman dismounts and shoots him. At some of these huntings twenty or thirty shots have been fired before he was subdued. On such occasions the bleeding victim grew desperately furious from the smarting of his wounds and the shouts of savage joy that were echoing on every side. From the number of accidents that have occasionally happened this dangerous hunt has been seldom practised of late years

<sup>1</sup> There was, however, a breed of the same cattle at Gisburne Park in Yorkshire, which was hornless. See “The Wild White Cattle of Great Britain,” by the Rev. John Storer.

—the park-keeper generally going alone and shooting one of the animals with a rifle.

“When the cows calve they hide their young ones for a week or ten days in some sequestered situation, suckling them two or three times a day. If any person comes near the calves, the latter press their heads close to the ground, and lie like a hare in its form in order to conceal themselves. This is a proof of their native wildness, and is corroborated by the following circumstance, which happened to the writer of this narrative. He found a hidden calf, two days old, very lean and very weak. On his stroking its head it got up, pawed two or three times like an old bull, bellowed loudly, retired a few steps, and then charged at his legs with all its force. Once more it pawed, bellowed, stepped back, and charged as before; but the intruder knowing its intention, and stepping aside, it missed him, and fell, and was unable to rise again, although it made several efforts. It had, however, done enough; for the whole herd was alarmed, and, coming to its rescue, obliged him to retire. The dams will allow no person to touch their calves without attacking him with impetuous ferocity.

“When any one of the herd happens to be wounded, or grown weak or feeble through age or sickness, the rest set upon it, and gore or trample it to death. There is rarely, however, any sickness among them, and they are seldom suffered to become more than eight or nine years old.”<sup>1</sup>

The question has been raised, and pretty fully discussed, as to whether the wild cattle just described are identical with the progenitors of the various breeds of this country which will presently come under our notice. The whole subject is so beclouded with mystery, and the evidence required to enable us to come to a decision on the point goes so far back into the history of our own country, that records are not to be met with, or, if available, cannot be trusted as authentic. All that is

<sup>1</sup> “The way from Belford to Chillingham is over a fine wild moor. Kyloe Crags, the Field of Flodden, Ford Castle, on whom old Cheviot himself looks down, Ross Castle with its Heronry, and Hepburn Wood, dear to the woodcock, are all in the expanse of rock and ling, while Chillingham Park rises as it were terrace upon terrace, with the white dots, not far below the sky-line, which tell of its famous cattle. There

‘They are grazing, their heads never raising—  
There are forty feeding like one,’

and we have to discard at the first glance every wild-bull-thought for Wordsworth’s milder rhymes. Our ideas change an hour after, as on the keeper’s old horse we ride the hill, and cautiously keeping near a strongly-fenced plantation, so as to be able to abandon the horse on an emergency, and retreat over the rails, we get within a hundred yards of them. We might have got nearer, but a herd of startled bucks trotted past them, and as one rose they all rose, and moved off at a foot’s pace, the old bull behind, and the king bull leading. The latter will find years tell on him in his turn, and when he is seven or eight, two younger ones will attack him fore and aft, and he will walk moody and downcast like the deposed monarch in the rear. . . . Like Highland herds going along a road they are subject to panics, and two gallops in the course of a week one season, owing perhaps to the rustling of deer near them, cost nearly every cow her calf. The calves are dropped in the fern, but they are sad little Tartars; and if they have been housed, it takes nearly two months to take off the tame smell. . . . Their sense of smell is exceedingly acute, and a cow has been seen to run a man’s foot like a sleuthhound, when he had run for his life to a tree. While Sir Edwin Landseer was taking sketches for his celebrated pictures, the herd went into action, and he was glad to fly to the forest as they passed by.”—“Saddle and Sirloin.”



left us, therefore, is conjecture, and that of a vague and unsatisfactory kind. There is, however, nothing to militate against the notion that all the breeds, with their distinctive and sometimes apparently most opposite characteristics of form and habits, which minister to the convenience of the population and add to the wealth of the country, have descended from wild cattle such as those of Chillingham Park. Nor is it difficult to believe this, when we consider that circumstances of climate and locality—which very much influence the peculiarities and habits of plants—may also, and in point of fact do, influence those of animals. It has been well remarked by an able writer :—

“Circumstances alone will have a great tendency to change the conformation and characteristics of a species. Thus, in cold countries, the white prevails as a colour, and fur or wool as a coat. In warmer climates, the brown prevails as a colour, and hair as a covering; while in those absolutely hot, the dun seems to obtain as a colour, and down as a clothing. So easy is the adaptation of organised beings to the state in which they are placed, and so vast is the expansibility of Nature, that she can extend or shorten, or increase or diminish conformation, so as to render it suitable to the wants, the happiness, and the existence of the animal. . . . And it is possible that the influence of a pasture may lengthen or shorten the horns—that by breeding from long or short-horned, or from hornless animals, the variety may be perpetuated till they lose in the course of ages many of their original characteristics. It is impossible, for instance, in Essex, to grow the ox to the same size, other things being equal, as in the county of Durham; nor on the Ayrshire hills can he be produced in the same form or stature as in the Devonshire valleys. The Highland Scot is suited to the cold climate of the exposed and stormy North, and the Shorthorn to the sunny Lowland pastures; and who shall say that the God of Nature has not impressed on those created beings the capability of adapting themselves to His plastic handiwork, of developing their tendency to follow the peculiarities of the situation in which they are placed? An elephant can never degenerate into a mouse, a cat never improve into a tiger; but a wild dun cow of Warwick may be the progenitor alike of the thin, spare, delicate-looking Jersey and the flesh-mountain ox of Durham.”

The same forcible writer concludes by quoting Dr. Pritchard, who says :—“In all our stock of domesticated animals we see profuse and infinite variety, and in the races of wild animals from which they originally descended we find a uniform colour and figure for the most part to prevail. Domestication is to animals what cultivation is to vegetables, and the former probably differs from the natural state of the one class of beings in the same circumstances which distinguish the latter from the natural condition of the other class. The most apparent of these is the abundant supply of the peculiar stimuli of each kind. Animals in a wild state procure a simple and unvaried food in precarious and deficient quantities, and are exposed to the inclemencies of the seasons. Their young are produced in similar circumstances to the state of seedlings which spring

uncultivated in a poor soil; but in the improved state, all the stimuli of varied food, of warmth, &c., are afforded in abundance, and the consequence is a luxuriant growth, and *evolution of varieties*, and the exhibition of all the perfections of which each species is capable."

Previous to the issue of the last edition of this work in 1877, another and a warm discussion was raised on the subject of the Wild Cattle. In the controversy which arose, several writers, some of them eminent as breeders of farm stock, took part. They set themselves to discuss the problem: "Was there ever an aboriginal breed of cattle in this country?" From this question arose another: "And if there was a breed from which all other breeds have descended, was this represented by the White Cattle, and were the cattle now known to exist at Chillingham Park the descendants of these?" The discussion, heated though it was, ended very much where it began, leaving the whole problem surrounded with the doubt and uncertainty which still enshroud it. Nevertheless, those who maintained that the Chillingham Park cattle were the true descendants of an original breed appeared to have the best of the argument. The latest authentic information respecting our native wild cattle cannot fail to interest all breeders of bovine stock, and will be found pleasantly written in "The Wild White Cattle of Great Britain." Still more recent, however, are the details we now proceed to give.

*Herds of Wild Cattle in the Parks of Great Britain.*—In the Report of the British Association for the Advancement of Science (1887), there is published the report of a committee which was appointed "for the purpose of preparing a report on the herds of Wild Cattle in Chartley Park, and other Parks in Great Britain." It is there stated that the Urus (*Bos primigenius*) was probably the only indigenous wild ox (*i.e.*, of the genus *Bos*; there was in addition the Bison), not alone in this country, but throughout the Palæartic region, and was the source of all our domesticated breeds, as well as of the White Park Cattle. But while we may fairly trace these park herds back to the Bubali or Tauri sylvestres, mentioned by Matthew Paris, Fitz-Stephen, and others as occurring down to mediæval times, whether these animals were genuine Uri, or *feral* cattle, is doubtful. The original Urus was a huge beast, while the park cattle, as we know them, are smaller than many domesticated breeds; but deterioration in size would be a natural result of their way of life and long-continued in-breeding. The prevailing white colour of the park herds (with that tendency to throw black calves which still exists in most of them, and which is specially apparent when any admixture of blood takes place) is probably a result of the same cause, and not the original colour of the Urus. White cattle had a special value, according to the Welsh laws of Howell Dha (A.D. 940), as is also proved by the present which Maud de Breos<sup>1</sup> sent to appease King John. With the exception of the Lyme

<sup>1</sup> Speed in his "History of Great Britaine," 1611, states that Maude de Breos, in order to appease King John, whom her husband had offended, sent to his queen a present from Brecknockshire of four hundred cows and a bull, *all white with red ears*. Whether, remarks Mr. J. E. Harting, this was the usual colour of the ancient breed of Welsh and British cattle, or a rare variety, esteemed on account of its beauty, and chiefly preserved in the

The following list shows the localities of all the herds remaining until recent years in the British Isles, arranged according to the probable order in time of their arrival at their several abodes:—

Chartley Park, near Uttoxeter, Staffordshire (the Earl Ferrers), appears to have been enclosed by the middle of the thirteenth century. This herd was dispersed in 1905, when it consisted of forty-three head.

Chillingham Park, near Belford, Northumberland (the Earl of Tankerville), seems to have been enclosed before the latter part of the same century, and probably as early as (or even before) 1220; it should therefore, perhaps, have been placed first.

Cadzow Park, Hamilton, Lanarkshire (the Duke of Hamilton, K.T.). Date of enclosure unknown, but the present park occupies a portion of the old Caledonian Forest, in which Robert Bruce is traditionally stated to have hunted the wild bull in 1320, and where, in 1500, James IV. of Scotland took part in the same wild sport.<sup>1</sup> In June 1892 this herd numbered thirty-eight, including twenty-two cows, eleven bulls, and five yearlings.

Lyme Park, near Disley, Cheshire (W. J. Legh, Esq.), at the latter part of the fourteenth century. Became extinct in or about 1884.

Somerford Park, near Congleton, Cheshire (Sir Charles W. Shakerley, Bart., C.B.). The cattle cannot be traced here more than about 200 years back, though it is possible they may have been here since the original enclosure of the park. It is perhaps more likely that they were brought in the seventeenth century from Middleton Park, Lancashire, the herd here in turn having come, it is supposed, from Whalley Abbey.

The Middleton herd is now represented by off-shoots (to some extent cross-bred, however, and now, like the Somerford herd, domesticated) at Blickling, near Aylsham, Norfolk (the Marchioness of Lothian), and at Woodbastwick Hall, near Norwich (A. Cator, Esq.). The cattle were removed from Middleton about 1765 to Gunton Park, Norwich (Lord Suffield), where they became extinct in 1853; but some had meanwhile—between 1793 and 1810 according to Storer—been introduced to Blickling, and others in 1840 were sold to Mr. Cator of Woodbastwick.

The herd at Vaynol, near Carnarvon (G. W. Duff-Assheton-Smith, Esq.), was started in 1872 from stock purchased from Sir John

parcs of the nobles, cannot be determined with certainty. It is, perhaps, more natural to suppose that they were all domesticated, and not wild cattle. In later records, however, wild cattle are particularly referred to by this name. "Six wylde bulls" are included in the bill of fare on the occasion of the feast given at the installation of George Nevill, Archbishop of York, in 1466.

<sup>1</sup> Sir Walter Scott has immortalised these cattle in his ballad of "Cadzow Castle":—

" Mightiest of all the beasts of chase  
That roam in woody Caledon,  
Crashing the forest in his race,  
The mountain bull comes thundering on.

" Fierce, on the hunter's quivered hand,  
He rolls his eyes of swarthy glow,  
Spurns with black hoof and horn the sand,  
And tosses high his mane of snow."

Powlett Orde, of Kilmorey House, Argyllshire. This stock (now somewhat crossed) was originally at Blair Athol, Perthshire. In 1834 the herd was sold to the Marquis of Breadalbane, Taymouth, and to the Duke of Buccleuch, Dalkeith. When the herd of the latter nobleman was broken up, the late Sir John Orde purchased the only survivor, and transported it to Argyllshire. In 1886 the entire remainder of the Kilmorey herd was transferred to Vaynol, and added to the cattle already there.

At Chillingham, Chartley, and Hamilton, the heads of the wild cattle seem slightly larger in proportion to their bodies than those of ordinary cattle, the feet larger and broader, and the legs stouter. May not these be taken as indications of a certain amount of deterioration in their size? At Chillingham the cattle have a "fine-drawn" almost "washed-out" appearance, which may be considered the result of close breeding, and the fact that more male than female calves are born is probably the effect of the same cause. It is interesting that in the semi- or wholly-domesticated herds at Vaynol, Somerford, and Woodbastwick the calves are extremely shy when first-born, and only become accustomed to human beings by degrees.

In the following abbreviated details the herds are taken in geographical order, from north to south:—

*Hamilton (Cadzow).*—On August 22, 1887, the herd comprised sixteen bulls and bull calves, and forty-four cows and heifers, the total being sixty head against fifty-four at the beginning of the year. There is a good deal of black on the fore legs in this herd, whilst the hoofs are black, also tips of horns, roof of mouth, and circle round eyes; black calves are frequently born. In 1884, a bull, considered to be a Highland bull, arrived from Kilmory; he was marked precisely like the Hamilton cattle, but one of his progeny was white all over, and another was black, so the bull and all his stock were killed. The new blood was introduced in consequence of a belief that the herd was deteriorating from too close breeding. In 1886 a bull was procured from Chillingham, and perhaps greater interest attaches to the result of this admixture of blood than to any other event of recent years in connection with the White Herds. The first two calves were born in March, 1887, and three others somewhat later. Of these, four were bull calves and one was a heifer calf. Three of the bull calves took after their sire in having brown ears, and were destroyed. The remaining bull calf was described as beautifully marked, with black points after the Hamilton pattern. In the heifer calf the ears were slightly tipped with a few brown hairs. There is no certain evidence of fresh blood having been previously introduced into this herd, however unlikely (as pointed out by Storer) it may be that a small number of cattle could for centuries have been continually bred only in-and-in, and still exist as a herd. According to Storer, however, Sir John Orde was told that one, if not two, Highland bulls bred in the herd some years ago. In this herd the calves are all born in spring and early summer; to ensure this taking place the bulls are kept in a run apart from the cows during most of the year. When grass is scanty, hay and turnips are given,

and the cows get, in addition, a little cotton-seed cake. The keeper, after twenty years' experience with the herd, says they are much less wild and dangerous now than formerly, in consequence of their being of late years visited by many people.

As to the probability that this herd was formerly polled, Joseph Dunbar, who had been in the ducal service for half a century, stated that, in 1842, the cattle were all hornless, and that the present Duke's grandfather caused all showing the least appearance of being horned to be killed.

*Chillingham.*—The average number of the herd for many years has been maintained at about sixty head. The births have averaged over nine a year, and the deaths about the same. The causes of death, besides the shooting of oxen and occasionally of an aged or sickly bull or cow, include old age, drowning, injuries received in fighting, rupture, cancer, fall, and other injuries; poverty and want of food; and, in calves, the failure of the dam's milk. The cattle live on good terms with the red deer, but they will not tolerate fallow deer or sheep in the park, possibly because these eat the pasture too close, or more probably from the fact that the red deer were, like themselves, primæval denizens of the forest. They will never touch turnips. During the last few winters, silage has been given them along with the hay. For a long time, however, they would not touch the silage; they sniffed at it and turned away. Even when all the hay had been eaten the silage was still left uneaten. At length a young bull was seen to try it; he went back to the herd and they returned to the silage with him. Since then the silage is always finished before the hay is touched. It is not deemed prudent to give very much of this material, as it appears to over-stimulate for a time the flow of milk, after which the latter fails. One obstacle in the way of increasing the herd is that the cows continue to suckle a calf even after a second has been born; the latter is consequently left to starve. The calves dropped in winter suffer from want of milk. The herd is subject to sudden panics, owing to strangers who frighten the cattle on purpose to see them run. It is denied that any calves are dropped coloured. They are claimed to be always white, with black extending very slightly beyond the naked part of the nose, and with red ears; though in Bewick's time (towards the end of last century) there were some with black ears, and from the steward's book in 1692 there appeared not only to be several animals with black ears, but some which were apparently entirely black, and one which was brown. Bewick, in his "Quadrupeds," 8th ed., 1824, says, "About twenty years since there were a few at Chillingham with *black ears*, but the present park-keeper destroyed them, since which period there has not been one with black ears." It is believed that Culley's celebrated Shorthorns at the beginning of this century were bred by a cross secretly obtained with a Chillingham wild bull; and Bewick, in his work just mentioned, remarks, "Tame cows, in season, are frequently turned out amongst the wild cattle at Chillingham."

At the Newcastle-upon-Tyne meeting of the British Association in 1889, Mr. R. G. Bolam, in writing the Guide to Chillingham, remarked

that the cattle are certainly as wild at the present time as in any past record, and that though they will come down to the hay-cart to be fed during the winter, they are almost unapproachable in the summer, when the greatest care has to be exercised to obtain a view of the herd, as at the least alarm they start off to their sanctuary, "Robin Hood's Bay." In 1749, May 24, Joseph Hutchinson, agent at Chillingham, said in the course of a letter to Lord Tankerville, "Your Lordship has now too great quantity of wild cattle that they will yearly die of old age and the rot, and if the distemper comes all will go. With submission to your Lordship if any get fat this season, it would not be amiss, with your Lordship's orders, to kill and lessen the breed. Fifty-one destroy a vast quantity of hay." In 1793, February 22, John Bailey, then agent, wrote with regard to the deficiency of the bulls, "I shall only say that it was entirely owing to inattention, and that the breed were within a hair's-breadth of being lost, which I think your Lordship, as well as every naturalist in the kingdom, would have very much regretted." In more recent years, when accurate accounts have been kept, the number has varied from forty-nine in 1864 to seventy at the beginning of 1889 (twenty bulls, thirty-six females, and fourteen oxen), the highest birth-rate in any one year (1872) having been thirteen. A careful record is now kept of the wild cattle killed from time to time, from which it appears that the average weight of the bulls is 350 lb., and of the steers, 560 lb. The case of the young bull sent on January 30, 1866, from the Chillingham herd, at the Duke of Hamilton's request, to Cadzow Forest, to improve the herd there, is the first and only instance on record of any of the Chillingham wild cattle being taken from the place alive.

In 1876 Lord Tankerville, with the object of testing the theory enunciated by the Rev. John Storer, author of "The Wild White Cattle of Great Britain," that Shorthorns probably had their origin in the wild herds of the country, tried to effect a cross between a wild bull and some well-bred Shorthorn cows. The finest produce of these were some very fine animals exhibited at the Royal Agricultural Society's Show at Kilburn, in 1879, but as they did not come up to his Lordship's expectations, the plan was abandoned until 1883. In the latter year Lord Tankerville tried the alternative of a cross between a Shorthorn bull and a wild cow, and magnificent specimens of the result may be seen in the paddocks at Chillingham.

*Somerford.*—In July, 1887, the herd comprised thirty head—three bulls and twenty-seven cows and heifers. No steers were reared; all surplus bull calves were fed for veal. These cattle weigh up to fifteen scores to the quarter when fed for beef. They are thoroughly domesticated, and allow one to move freely among them. The cows are regularly milked, and they are as a rule excellent milkers, whilst their butter is pronounced to be the best in the country. One cow yielded up to as much as thirty-three quarts of milk per day, but she died in four months. These cattle are polled, and no exception is recorded. They are black pointed, but there is considerable range in the markings—far more than in any of the other herds. About 1876 a young bull was

exchanged with the Blickling herd (Marchioness of Lothian's), and the cross succeeded fairly well, a peculiarity in the strain being that many are born with the ears square-tipped, as if the animal had been marked by cropping. About 1879 a young bull was exchanged with the Woodbastwick herd (Mr. A. Cator's); this bull was *brown* pointed, but threw calves with red ears and muzzles, which were the first so marked known to have occurred at Somerford. Of the cows and heifers in the Somerford herd, eleven have either very little black fleckings about the body, or even none at all; while about six have a good deal of black in thickly grouped fleckings, spots, and small patches. One cow, about ten years old in 1887, was described as a blue roan, black and white hairs being placed almost alternately over the greater portion of her body, giving her a *blue-grey* colouration. The fronts of her fore-legs below the knees were black, and so was the whole outside of her ears, instead of, as usual, only one-third or a half at the distal end being thus marked; this cow was giving twenty-four quarts of milk per day. Another cow was red pointed, and slightly flecked on the neck with the same colour. The black on the nose in most of the cattle extended evenly round the whole muzzle, including the under jaw, but some had merely the naked part of the nose black, and in one or two even this was rusty coloured and not perfectly black. All, excepting the red-pointed cow, had a narrow rim of black round the eyes. The animals with the least black about them appear to have the finest bone and the smallest heads; this may be following the old strain, while the others perhaps more nearly follow the cross-strains. The red-pointed cow and one of the quite white ones had small knobs or excrescences on either side of the frontal bone, like budding horns, but they did not protrude through the skin. One of the handsomest of the cows was almost entirely white, and was the daughter of a cow that died in 1887 at the extraordinary age of twenty-three years; at Chillingham they rarely reach ten years. She was very dark, although of the old strain, and had withstood infection during the cattle-plague epidemic.

The bulls appeared to be very strongly made, very broad across the thighs, short on the legs, and with remarkably broad thick-set heads. They were plentifully flecked with black, and in the younger of the two the fleckings extended to the lower part of the face, while the black on his muzzle was broader than in probably any other example of park cattle. The cows produce their first calves when from two years to two-and-a-half years old. The bulls run with the herd throughout the year, but, in order that the birth of calves may be in some degree regulated, individual cows are temporarily shut up. The udders of the cows here are as large as those of ordinary domestic cows, but this is not the case in the herds which are not milked. In winter all the cattle, especially the bulls, develop long hair on the poll and neck, which divides along the central line and covers them like a mane. The hairs decrease in length backwards to the withers, where they cease somewhat abruptly. About 180 acres of the park are allotted to the cattle; it consists of excellent upland turf sloping down to the River Dane. In winter the cattle are housed at night, and supplied with hay.

*Chartley.*—In July, 1889, the herd numbered thirty-four head—nine bulls, five bullocks, and twenty cows and heifers. The existence of this herd seems traceable at least as far back as that of the Chillingham—to 1248–49, according to Sir Oswald Mosley. The colour was uniform—white, with black nose, ears and feet, sometimes ticked. Occasionally black calves were born, but they were not kept. The number of calves reared annually averaged about half the number of breeding cows. There is no evidence or knowledge of fresh blood having at any time been introduced. Lay cows were formerly admitted to the park, and crosses with the wild bulls obtained, but this was stopped more than twenty years ago; the result of these crosses was very good beef, but the cross-breeds were very difficult to milk or handle. The animals in this herd were heavier in front and lighter behind than in any of the other herds; in general shape and character both of bodies and horns, they closely resembled the old domestic breed of Staffordshire Longhorns. The udders of the cows were remarkably small, and inclined forwards at an angle—very unlike the huge gland of a domestic cow. In winter the cattle were fed on hay in sheds. The park occupies nearly one thousand acres, and is in its natural, original condition. It has never been manured, or broken up, or sown with seeds.

*Vaynol.*—In August, 1887, the herd consisted of fifty-three animals, namely, one old bull, two young bulls, about twenty cows, and about thirty heifers and calves of both sexes. They are short-legged, straight-backed animals, and are all white with black muzzles, black tips to the ears, and more or less black about the hoofs; this varies, however, with the individuals, some being only faintly marked in this way. They all have horns, not very long, but sharp, and turned up at the ends, though not quite uniform. In winter they are fed with hay, but they are never housed, and the cows are never milked. The beef is excellent.

The original importation of the Vaynol herd from Kilmory took place in 1872, and consisted of twenty-two head—one bull, nine cows, six heifers rising two years, six yearling steers. In August, 1886, the remainder of the Kilmory herd followed; it comprised two yearling bulls, fourteen cows and heifers, eight two-year-old heifers, and eight yearling heifers—thirty-two in all. At some time within six or eight years of the first instalment of cattle coming to Vaynol, a black bull-calf was born. Deaths are rare, and do not extend beyond a calf or two dying of “scouring.” The cattle, although never handled, or housed in winter, are not fierce, and will allow a near approach (except when they have calves) without showing any signs of impatience or alarm. Since the arrival of the two instalments of the herd at Vaynol, no fresh blood has been introduced, nor have any exchanges been effected; nevertheless, Mr. Assheton Smith is of opinion that the cattle have improved both in size and weight. About two hundred acres of park, consisting of old artificial pasture, bordering a lake, are allotted to the cattle. This run is shared by red and fallow deer, and there are a few roe deer in the plantations around the park, descended from Scotch and German stock.



The origin of the Kilmory herd was, according to Storer, the purchase by the late Sir John Orde, in 1838, of a bull, the only survivor of the Duke of Buccleuch's (Dalkeith) section of the old Athol herd. This bull was used with Kyloe (West Highland) cows, carefully selected. After some years he was exchanged with one of Lord Breadalbane's (Taymouth), and the latter was used with good results until 1852, when a West Highland bull-calf was bought, and this sire was supposed to have much improved the stock. No further crosses were made up to 1879, since when the present Sir John Orde has effected crosses with ordinary Highland, Ayrshire, and Indian cattle. The first-named cross was the only one found desirable, the produce of certain cows, that proved infertile with the wild bull, being very satisfactory in everything except colour; the cattle show traces of their Kyloe extraction.

*Blickling*.—In July, 1889, this herd numbered twenty-one head—four males and seventeen females. Mr. Storer says these cattle were introduced from Guntton about the beginning of the present century, that some years ago rinderpest killed off all but about three or four, and that the herd has since then been somewhat made up and consequently altered. The cattle are black pointed (muzzles, ears, and hoofs); sometimes the points are red, and sometimes there is no colour about them at all. They are frequently spotted like flea-bitten Arab horses. Of six heifers born in 1889, two had black ears but no spots, while one had red ears and another white ears. All calves with black points are preserved. By the advice of Mr. Storer a cross was obtained from Somerford, two young bulls being sent thence, one of which had an incipient horn. There was another cross about 1882 with a cow from Yorkshire, which in appearance was like the cows in the Blickling herd; it was out of a white Shorthorn by a black Galloway. No horns have appeared among its descendants, though one cow always throws black calves (which are never reared); and on some of the others the black points have been more than usually pronounced. As soon as the animals are adult, and are taken into the dairy herd, they no longer range in the park, but are fed in meadows. The land is light, and the animals receive cotton-cake all through the summer; in winter this is supplemented by hay, but no roots are given. In cold weather they are housed at night.

*Woodbastwick*.—In August, 1887, there was one bull, with twelve cows, and about a dozen head of young stock. Originally all these cattle had red ears and red muzzles. Latterly, however, from want of fresh blood, it has been impossible to maintain the red points. A red pointed bull, received in exchange from Somerford about 1879, proved useless. Mr. Cator was therefore obliged to use a black-and-white bull, sent from Somerford, which had (as was supposed) some black Angus blood in him. The stock by this strain have nearly all had black points, though some few have points of a dark chocolate colour. This bull had a good deal of black on his back, and the calves at first took after him, being in most cases more or less spotted with black. As he got older, however, the calves took after the cows, and

in 1883, which was the last year he was used, all the calves came pure white, save black ears and noses. The next bull used was a son of the last, and the result was satisfactory as regards markings, although more calves were black- than red-pointed. At different times some three or four Shorthorn bulls have been used, with a view of improving the hind-quarters, which are rather light. The animals are inclined to be weak in the loins, and their coats get very fine. This last cross did not prove very successful as regards marking, all the calves turning out pure white, ears and all, a few having a promise of horns; while the character of the head differs from that of the old type, which was short and broad between the eyes. The cattle, from interbreeding, became delicate and thin in the coat, but the Shorthorn cross much improved this. The white of the Shorthorn appears yellow by the side of the pure white of the park breed. Though not considered hardy, the cattle are good milkers when well fed. This herd originated from Gunton stock, the late Mr. Cator having bought one cow at a sale about the year 1832. This cow threw a bull-calf, and at various times subsequently the herd was recruited by red-pointed calves from Blickling. These cattle are kept in fields, and do not enjoy the wide range of a park. The soil is poor and gravelly. The animals are stalled all the winter and fed on turnips, and in severe weather oilcake is given in addition.

The following wild herds mentioned by Mr. Harting are all now extinct,—where possible the date, exact or approximate, of extinction is included within parentheses:—Ardrossan Castle, Ayrshire (1820); Auchencruive, Ayrshire (between 1763 and 1784); Barnard Castle, Durham (since 1626); Bishop Auckland, Durham (1646); Blair Athole, Perthshire (1834); Burton Constable, Yorkshire (before 1790); Drumlanrig Castle, Dumfriesshire (about 1780); Ewelme Park, Oxfordshire; Gisburne Park, Yorkshire (1859); Houghton Park, Lancashire (about 1680—1700); Holdenby Park, Northamptonshire; Leigh Court, Somerset (the only instance yet known of a wild herd in the West of England; there is no clue to their origin, and in 1806 they had become so savage that the owner was obliged to have them shot); Lyme Park, Cheshire (1884); Middleton Park, Lancashire (herd removed in 1765 to Gunton Park, Norfolk, where they ceased to exist in 1853, though not before some of the cattle had been transferred to Blickling Hall, and others to Woodbastwick); Naworth Castle, Cumberland (before 1675); Whalley Abbey, Lancashire (1697, about which time the herd appears to have been divided between Gisburne Park and Middleton Hall); Wollaton Park, Nottinghamshire (between 1800 and 1835). In Ireland no trace of these wild cattle has been discovered, although remains of the smaller *Bos longifrons* have been found in many Irish localities.

The subjoined remarks are taken from Mr. J. E. Harting's account of Wild White Cattle, in the appendix to his "Extinct British Animals":—

The few scattered herds of so-called Wild White Cattle which still exist in Parks in England and Scotland may be said to form a

connecting link, as it were, between the wild animals which have become extinct in this country within historic times, and those which may still be classed amongst our *feræ naturæ*.

The race is undoubtedly of great antiquity, but whether it is descended, as some affirm, from the aboriginal wild breed of the British forests—the Urus of Cæsar (*Bos primigenius*)—or whether, as others assert, it has at some period long remote been imported from abroad and since become feral, are questions upon which, at present, considerable difference of opinion prevails. The weight of scientific opinion, however, seems to favour the view that these wild white cattle were descended from the Urus, either by direct descent through wild animals from the wild bull, or less directly through domesticated cattle deriving their blood principally from him.

That the Urus existed in Britain in prehistoric times, and was contemporaneous with man of the Palæolithic or older Stone Age, must be admitted. In the fluviatile deposits of the Thames, and in some other places, the remains of the two have been found together, and instances have been recorded in which the remains of the Urus have been found contemporaneous with man of the Neolithic or later Stone Age.

In these and other instances which have been recorded, the animals whose remains were found were, in all probability, wild, and not domesticated. Indeed, no discoveries have yet been made which lead to the supposition that the Urus was domesticated in Britain in prehistoric times; while *Bos longifrons*, the “Celtic short-horn,” as it has been termed, was everywhere subjugated and used by man. The latter was the only Ox in Britain in the time of the Romans, and afforded sustenance to their legions. From it the small dark breeds of Wales and Scotland are descended; and it survived until recently in Cornwall, Cumberland, and Westmoreland. The remains of *Bos longifrons* are plentiful in the English fens, and it seems to have afforded a staple article of food in the Neolithic Age.

Mr. Sydney Skertchley found immense numbers of the bones of this animal in what are probably the remains of a Stone-Age lake-dwelling at Crowland, near Peterborough. At the great flint-implement manufactory at Grimes Graves, near Brandon, Suffolk, the remains of this animal are very plentiful, and are chiefly those of young calves. It would appear from this that a principal article in the food of these people was milk, and therefore they could not afford to keep the calves, which must have consumed a large portion of what would otherwise have been available for the use of the household.

Before leaving this branch of the subject it will be useful to record the opinion of an eminent and trustworthy authority, who, writing to us in the summer of 1891, says: “My own acquaintance with modern British breeds of cattle leads me to incline to the belief that most of them have sprung from an ancient British race, or perhaps from two distinct races which existed in the British Isles before the Saxons came, mixed at various times with cattle brought over by different races of men. Some breeds—the Chillingham, the Welsh, the West

Highland, for example—may, perhaps, differ less than other breeds from one ancient type.”

THE DAWN OF IMPROVEMENT.—Having given an account of the herds of semi-wild white cattle, we might now proceed to describe the existing breeds of improved stock. Before doing so, however, it seems to be desirable to connect the past with the present, and to briefly recount the early history of the improvement of our domesticated animals. At what date the improvement first began it is impossible to say. We know that, in other countries, herds and flocks received attention at a very early period. Judging from Virgil's directions to “Note the tribe, the lineage, and the sire,” it would appear that the science of breeding had been brought to a high state of perfection by the Romans. In England, distinct evidence of skill in breeding does not occur until the seventeenth century.

As might be expected, the first advances in agriculture in this country were accomplished in the practice of cultivating the soil. Thus Fitzherbert's “Boke of Husbandrie” was published in 1524; Tusser's “Five Hundred Points of Husbandry” was printed in 1562; Hartlib's Legacy had been brought under the notice of the public two years earlier, and in 1701 came Jethro Tull's “Horse Hoeing Husbandry.” Several of these volumes—particularly that of Hartlib—gave notes upon live stock, but they were all mainly devoted to the management of the land and the growing of crops. It is probable that, on the rich ground surrounding the monasteries, live stock were carefully reared by the monks of old, but no precise details as to their operations have been preserved.

A condition absolutely necessary to the skilful breeding of stock is freedom from disturbance by warriors or marauders. The work takes several years to show its results, and cannot brook interruption by a peremptory demand to don armour and serve the country on the battlefield, or by the necessity to repel the advances of a party of harrying freebooters and cattle-lifters. Peace is essential to successful stock-breeding. Therefore, in looking for the causes that first gave definite form to the development of the live stock industry, we have to examine the constitutional history of the country.

In 1707 was consummated the legislative union between England and Scotland. The peace which it was hoped would quickly be established led, in 1723, to the formation of the Society of Improvers of Agriculture in Scotland. But the worthy men who organised that earliest of our Agricultural Societies had incautiously reckoned upon an immediate and absolute cessation of hostilities, which did not all at once occur. The valiant “Improvers” struggled courageously amid the fierce troubles between the two divisions of the country, which soon again broke out. These conflicts grew in intensity, and the Society seems to have been dissolved in 1746, when the battle of Culloden finally brought to a close the horrors of civil war, which has been described as the most ancient and deadly foe of agriculture.

The date of the decisive engagement at Culloden may, for all practical

purposes, be taken as that when scientific stock-breeding commenced in Great Britain on well-defined lines, and when scope was given for the victories of Peace which are not less renowned than those of War. In our opinion there are few of these achievements that are more remarkable than the subjection of the brute creation to the uses of man, and the immense increase of the national wealth which has resulted from the systematic rearing of live-stock for the purposes of food supply.

Apart from the improvement in the varieties of sheep with a view to the production of fine wool, which was largely the result of legislative enactments, directed to the furtherance of a special commercial object in the development of the nation, we find the first traces of a taste for live-stock in records of the value placed upon oxen for the plough. There are, for example, deeds in existence dating as far back as 1720 in which teams of oxen are specifically bequeathed by name. Here, however, we have to deal with the breeding of cattle as contributors to the food supply and not as animals of draught, and with the rearing of sheep for the production of mutton rather than for their wool-bearing properties. As usually happens when the time was ripe for a change, the man appeared, and what proved to be nothing less than a revolution in stock-breeding received its chief stimulus from, if it was not actually initiated by, the exertions of one great breeder. Robert Bakewell, of Dishley, in Leicestershire, was born in 1725, and began to breed horses, cattle, sheep and pigs about 1755.

In his "Observations on Live Stock," published in 1794, George Culley tells us that "the kind of cattle most esteemed before Mr. Bakewell's day were the large, long-bodied, big-boned, coarse, flat-sided kind, and often lyery or black fleshed. On the contrary, this discerning breeder introduced a middle-sized, clean, small-boned, round-carcassed, kindly-looking cattle, and inclined to be fat." Bakewell's sheep also, according to the same authority, "surpassed all other breeds in their propensity to get fat, and in paying the most money for the quantity of food consumed." Arthur Young was among Bakewell's numerous visitors, and he states that the principle that guided him was "to gain the beast, whether sheep or cow, that would weigh most on the most valuable joints, and, at the same time that he gained the shape that was of the greatest value in the smallest compass, he produced a breed hardier and easier fed than any other. The smaller the bones the truer would be the make of the beast, the quicker would it fat, and its weight would have a larger proportion of valuable meat,—flesh not bone being the butcher's object." It was in 1767 that Arthur Young made these observations. In 1785 Young paid a second visit to Dishley, and then said that "the leading ideal which governed all Bakewell's exertions was to procure a breed which on a given food would give the most profitable meat; that in which the proportion of useful meat to the quantity of offal was the greatest, also in which the proportion of the best to the inferior joints was likewise the greatest." These then were the objects at which Bakewell aimed.

The rules of breeding by which he accomplished them we learn from Culley :—"Mr. Bakewell has not had a cross from any other breed than his own for upwards of twenty years. His best stock has been bred by the nearest affinities, yet they have not decreased in size, neither are they less hardy or more liable to disorders, but on the contrary have kept in a progressive state of improvement." The idea, in short, was to breed the best from the best without regard to affinity of blood, on the principle that like begets like. This was the revolutionary doctrine which Bakewell taught by his practice—not that he proclaimed it to the world, for he was a reticent man, who preferred to work quietly, unobserved by the public. Yet the fame of his stock—whether cattle, horses, sheep, or pigs—spread to all lands, and the farm in Leicestershire attracted universal attention—Russian princes, French and German royal dukes, British peers, and sightseers of every degree flocked to Dishley—the breeders' Mecca—and the principles so successfully carried out there with the Longhorn cattle and the Leicester sheep were imitated by others—by Benjamin Tomkins with the Herefords in 1769, by the brothers Colling with the Shorthorns in 1770, and by Quartly with the Devons about the same time. How they progressed in the work we will now proceed to relate in the accounts of the modern breeds of British cattle and sheep, which are acknowledged to be the best in the world. The demand in Bakewell's day was for fat meat. Times have changed, and other live-stock improvers have had to provide beef and mutton with more lean and less fat in order to suit the altered taste of consumers. They have thus been compelled to vary their systems of breeding, but they have all proceeded on the lines inaugurated by Bakewell, adapting his broad general principles to the varied conditions that have arisen.

THE MODERN BREEDS OF BRITISH CATTLE.—In giving a general description of the breeds of cattle which are met with in various districts, and which claim the attention of the farmers of the British Isles, it will be appropriate to select those to which places are assigned in the catalogue of the Royal Agricultural Society of England at its Meetings. The sections for cattle at Newcastle in 1908 were the following:—Shorthorn, Lincoln Red, Hereford, Devon, South Devon, Sussex, Longhorn, Welsh, Red Polled, Aberdeen-Angus, Galloway, Highland, Ayrshire, Jersey, Guernsey, Kerry, Dexter Kerry. The Lincoln Red and the South Devons are recent additions to this list which now have herd-books of their own.

THE SHORTHORN CATTLE.—Under the denomination of Shorthorns—"the red, white and roan" of modern writers—are included the *Holderness* and *Teeswater breeds*,<sup>1</sup> which have been supposed to derive

<sup>1</sup> The Holderness, a fine, large-framed breed, with good backs, long quarters, remarkably clean and straight legs, and well-developed udders, grazed in the district north of the Humber. Many of them were white, with blue or bay flecks; but the largest number were dark mouse and white, and, as was natural from their proximity to Hull and their general appearance, they were thought to be of Dutch origin. Under the local name of "Teeswaters," the Shorthorns, to which the Holderness seemed to bear most affinity in character,

their origin from a cross with some large bulls that were imported by Sir William St. Quentin, from Holland into Yorkshire, in the East and North Ridings of which county the two latter breeds have been long established and deservedly esteemed. It has, however, been doubted whether any benefit was derived from this intermixture; for the advantage thus obtained in size was thought to have been counter-balanced by a more than proportionate increase of offal. But, fortunately, the error was not universal; for some intelligent breeders, aware, even at that day, of the superiority of symmetry to bulk, preserved the breed, of which they were already in possession, in its native purity; and it is from some of that stock, so maintained, that the present *improved Shorthorn* cattle, still in other countries known also as the *Durham breed*, are supposed by some to be descended.

Considerable doubt has, however, been thrown on this description of the origin of the Shorthorn, from the circumstance that importation of cattle from the Continent was most stringently prohibited during the whole of the eighteenth century. It is useless to speculate upon the subject, for speculation is vain, no authentic records being now available to enable us to describe what is, after all, no very important matter; enough for us to know, that the improved Shorthorn, now the chief breed of Great Britain, owes much to the skill of Mr. Charles Colling, of Ketton, in the county of Durham, and to that of his brother Robert. It is to Charles Colling that the main credit (*see* page 27) of introducing an improved breed is due, though he received his Shorthorns from other breeders, and notably from Mr. Maynard. Of this breed Charles Colling sold a bull in 1810 by public auction, for the—at that time—unrivalled sum of 1,000 guineas: Messrs. Wetherell, Trotter, Wright, and Change being the purchasers. This large sum has, however, been exceeded in a more recent time, by the sale of Colonel Townley's famous bull "Master Butterfly," to an Australian gentleman, for 1,260 guineas. Mr. Bolden sold, in 1856, to Mr. Thorne of New York, "Grand Duke," and "2nd Grand Duke," for 1,000 guineas each. Again, at the sale of the Earl of Ducie's Shorthorn herd at Tortworth, in 1852, "nine animals," the "Agricultural Gazette" informs us, "descended from Charles Colling's Young Duchess (three of them being calves), fetched the enormous sum of 4,160 guineas, averaging 462 guineas a-piece."

In Professor Sheldon's "Dairy Farming," page 13, we read:—

"In September, 1873, the bucolic world was startled by the results of a sale of Mr. Campbell's Shorthorns, at New York Mills, near

had got a strong hold in Durham several years before the close of last century; but still it was not until "the Durham Ox" commenced his six years of caravan life in 1801 that the doom of the Longhorns was virtually sealed.

The Teeswaters were cattle of great substance, but somewhat ungainly in form, and were thought to give less but richer milk than the Holderness. The fragments of history on which their origin rests are somewhat shadowy and uncertain. Some contend therefrom that they must be of Dutch origin, and only another version of the Holderness; and others, with equal zeal, that their tap-root is to be found in the West Highlands, or that the earlier breeders always fell back on its bulls for a cross if they thought their herd was losing constitution. There is certainly some confirmation of this opinion in the peculiarly sharp horns and ink-black noses which will appear at intervals.—"Saddle and Sirloin."

Utica, New York, America. At this sale six females of the 'Oxford' tribe averaged 1,087*l.* 10*s.*, and the bull-calves 396*l.* 16*s.* 8*d.* Eleven females of the 'Duchess' tribe made the prodigious average of 4,522*l.* 14*s.* 2*d.*, one cow fetching the unparalleled sum of 40,600 dollars, or, in our money, 8,458*l.* 6*s.* 8*d.*

"On the 4th of September, 1877, Mr. Thornton sold, at Bowness, fifty-five Shorthorns which Mr. Cochrane, of Canada, had sent over to this country for sale. The sum total amounted to 17,150*l.*, or an average of 381*l.* 2*s.* 2*d.* per animal. The average price of thirty-seven cows, heifers, and calves was over 420*l.*, and of eight bulls over 300*l.* The 'Third Duchess of Hillhurst,' red, calved December 25th, 1875, and consequently only twenty months old, was sold to Mr. Loder of Towcester for 4,100 guineas; and the 'Fifth Duchess of Hillhurst,' red, calved May 1st, 1876, and consequently only sixteen months old, was bought by Lord Bective for the still larger sum of 4,300 guineas!"

To the foregoing records the following must be added: At the sale of the Earl of Dunmore's Shorthorns at Dunmore, Scotland, by Mr. Thornton, in 1875, the bull, "Duke of Connaught," realized 4,500 guineas, and the average for 30 head was 672*l.* 8*s.* These were of the Bates blood. A few weeks afterwards the late Mr. Torr's herd of Booth Shorthorns were sold by Mr. Thornton at Aylesby, when the average for 84 head was 510*l.* 19*s.*

Such were the values of certain fashionable tribes in those days, but the position of the breed has since been rendered far more secure by greater attention to personal merit.

The history of the celebrated *Durham Ox*, the property of Mr. Charles Colling, is too remarkable not to merit attention:—

He was bred in the year 1796, and at five years old was not only covered thick with fat upon all the principal joints, but his whole carcass appeared to be loaded with it, and he was then thought so wonderful an animal, that he was purchased in February, 1801, for 140*l.*, to be exhibited as a show; his live weight being then 226 stones of 14 pounds. In the following May he was again sold for 250*l.* to Mr. John Day, who, two months afterwards, refused for him 2,000 guineas. On May 14 Mr. Day could have sold him for 525*l.*, on June 13 for 1,000*l.*, and on July 18 for 2,000*l.* He was exhibited in almost every part of the kingdom until February 19, 1807, when he fell and dislocated his hip-bone. Every remedy was attempted in vain, and on April 15 he was shot. Although he must have lost considerably in weight during his two months' illness, he weighed 187 stones 12 pounds;<sup>1</sup> and Mr. Day stated his live weight, at ten years old, to have been 278 stones.

Uncommon as was the weight of this animal, he was exceeded in size

<sup>1</sup> Viz. Four Quarters	165	12	}	See "Agricultural Survey of Durham," p. 233
Tallow . . .	11	12		
Hide . . .	10	2		
	187	12		



by a Yorkshire ox,—bred by Mr. Dunhill, of Newtown, near Doncaster, —whose weight was 264 stones 12 pounds. He was supposed to have lost nearly forty stones while being exhibited in London.

More recently, another beast of uncommon size, fed by Lord Yarborough, was exhibited under the title of “the *Lincolnshire Ox* ;” but, although bred in the county named from a favourite cow belonging to Mr. Goulton, he was got by a descendant of Comet out of Countess. This extraordinary animal measured five feet six inches in height at the shoulders, eleven feet ten inches from the muzzle to the setting on of the tail, eleven feet one inch in girth, and three feet three inches across the hips, shoulders, and middle of the back. The lowest point of his brisket was only fourteen inches from the ground. There was a distance of one foot ten inches between the fore-legs, and the girth of the fore-leg was nine inches.

The following account of the Kirklevington herd of Shorthorns, the property of Thomas Bates, is not a little interesting :—“It may be asserted with confidence that at the time of its dispersion or sale on May 6, 1850, this herd was unequalled by any other in existence. Magnificent size, straight and broad back, arched and well-spread ribs, wide bosom, snug shoulder, clean neck, light feet, small head, prominent and bright but placid eyes, were the features of usefulness and beauty which distinguished it in the highest degree. The hide was sufficiently thick to indicate an excellent constitution ; its extraordinary elasticity, together with the soft furry texture of the coat, evinced throughout the herd excellent quality of flesh and disposition to rapid taking on of fat. ‘Young Duchess,’ a two-year old heifer, got by Comet (the bull we have already spoken of), dam by Favourite, was the originator of that portion of this herd called the ‘Duchess family.’ One of her calves, ‘the Fourth Duke of York,’ now in the possession of the Earl of Ducie, is as fine a bull as England can produce. The only three calves yet got by him have realised the sum of 379*l.* 1*s.* The herd consisted of forty-eight cows, heifers, and heifer calves, and twenty bulls and bull calves, and realised a total amount of 4,558*l.* 1*s.*”<sup>1</sup>

“The far-famed Booth herd,” according to the excellent account given by Mr. Dixon in his review of the ‘Herds of Great Britain,’ “was commenced about 1790 by Mr. Thomas Booth with well-selected cows of the then existing Shorthorns, which he put to the best of Robert Colling’s bulls, among which was Twin Brother to Ben (660).<sup>2</sup> After these he used Son of Twin Brother to Ben, Suwarrow, Easyby, and the Lame Bull. We alluded to his purchase of Albion at the Ketton sale, and at Mr. Robert Colling’s sale he purchased Pilot, of the Wellington tribe, dam by Favourite, the Pilot and Albion crosses being the making of the herd. ‘Henceforward he only used those bulls which were bred in the herd ; and his sons, with the exception of a sparing use of Lord Stanley, Exquisite, Lord Zetland’s Lord

<sup>1</sup> “Farmer’s Magazine,” June, 1850, p. 532.

<sup>2</sup> This number is that referred to in the “Herd Book,”—each animal registered has its distinctive number by which it is known.

Lieutenant (sire of Leonard), have pursued the same plan' (Dixon). To these may be added Mussulman, the sire of the celebrated bull Buckingham (3239).

"To give even an abridged account of the many celebrated males and females which have sprung from the 'Booth Herd' would require a volume of itself; and there is no one who has the slightest knowledge of modern Shorthorns to whom the names of Hamlet, Buckingham, Leonard, Hopewell, Vanguard, Windsor, Crown Prince, Prince Arthur, British Prince, Prince of Warlaby, &c., among the bulls; and of Bracelet and her twin sister Necklace, Mantalini, Faith, Hope, Charity, Birthday, Bud, Hawthorn Blossom, Plum Blossom, Nectarine Blossom, Bridesmaid, Bianca, Queen of the May, Queen of the Isles, Queen Mab, Soldier's Bride, Bride Elect, &c., &c., among the females, are not quite familiar.

"Cattle of the pure 'Booth blood' are distinguished by their mellowness, the depth and width of their fore-quarters, and consequent fulness of girth, the uncommon spread of their ribs, their good backs and loins; but they are sometimes deficient in style, and rather plain in the head, and coarse in the horn, which peculiarities were brought in by the Leonard cross, and came to him from Thorpe (2757), the sire of Leonard (Lord Lieutenant) having been got by Thorpe. The celebrated Favourite had something of the same defect, being rather coarse in his horn. The Duchess tribe, on the other hand, are characterized by a great deal of elegance in the head and neck, but this is accompanied with defects, such as bareness in 'the side of the chest,' 'shoulders rough and prominent in their points, and bare of flesh,' as has been truly said by Mr. Carr. On the other hand, to use Mr. Carr's well-chosen words, in a Booth animal, 'the neck, fine at its junction with the head, increases rapidly, though not abruptly, in size, until it melts insensibly into the shoulders and wide projecting brisket, which again blend imperceptibly with the crop, fore-flank, and ribs, without any depressions or protuberances. When the animal walks the elbow joint is scarcely, if at all, seen, and there is no hollow behind it. The motion of the shoulder-blades and shoulder-points is imperceptible, the former being laid snugly back into the crops, the latter hidden by the full neck vein, which blends with the muscles of the shoulder, neck, and brisket, forming gently tapering lines to the head and breast end.' Now that the heat of rivalry has somewhat cooled down, and that the respective upholders of each of these famous strains of blood are prepared to acknowledge the merits of the other, it is considered that a judicious blending of the good qualities of each would be highly desirable; and such a union is, in fact, considered by several eminent breeders to be the very acme of Shorthorn breeding.<sup>1</sup>

"The colours which belong to the Shorthorn are rich red, pure

<sup>1</sup> The direct cross between Booth blood and Bates blood has sometimes proved excellent in its results, and sometimes has "spoiled both." But the distinctness of the two groups, which once existed, is rapidly passing away. Its exemplification may still be found in a few individuals, but its generality is lost.

white, and a mixture of the two in great variety, the most fashionable being a roan, more or less deep. A yellowish red is also occasionally met with, but it is not so much liked, although it prevailed at one time in some of the best animals of the breed; Hubback, for instance, was 'yellow, red, and white.' We have no right to object, therefore, to animals of that colour, on the score of purity of blood, although we have heard it done. Many dislike a white, but this seems rather a prejudice than an objection which can be traced to good grounds. It has been justly remarked 'that some of the very best of the improved Shorthorns have been white ones.'"

The following is a description of a Shorthorn animal,<sup>1</sup> from the pen of Mr. R. Smith, in the Journal of the Royal Agricultural Society (vol. xx. 1st series, p. 330):—"He should have a symmetrical and compact form, of sufficient size, on shortish legs; the body should be covered evenly with flesh, of a mellow and elastic nature, yet firm enough and springy to the touch, following the fingers when the pressure is withdrawn; the forehead should be open, without a contracted air about it, and tapering gracefully to the muzzle; the eye prominent, yet placid; neck moderately long, nearly running into the shoulders, which should be well laid, gracefully fitting into the fore-quarters: the girth good over the heart; the fore-arm, where it joins the body, broad and tapering, with fine bone below the knee, and fitting level into the girth, and so maintaining a straight line along the whole animal to the extremity of the hip; the neck vein should be prominent and well filled up with flesh, running neatly into the shoulder points, which should not be prominent (*i.e.*, rough), but well covered, and the muscle on the outside of the shoulder being well developed; the ribs should spring well and level from the backbone, increasingly so towards the back rib, which should be well home to the quarter—in fact, the space here (termed the false rib) should carry on in a straight line over the hip, gradually tapering on the side bones at the tail, but the quarter must be well packed, not 'scooped out,' so to speak; the hip-bones should be dovetailed into the quarter and false rib so completely that one ought to be at a loss where to find them—*i.e.*, they should not be too recognisable; the flank will then, as I have already said, be deep and full, forming a parallel line with the animal's back

<sup>1</sup> These doggerel lines, written more than half a century ago, may be accepted as describing the characteristics of a good Shorthorn cow of the time (1830):—

"She's long in her face, she's fine in her horn,  
She'll quickly get fat without cake or corn;  
She's clean in her jaws, and full in her chine,  
She's heavy in flank, and wide in her loin.

She's broad in her ribs, and long in her rump,  
A straight and flat back, without ever a hump:  
She's wide in her hips, and calm in her eyes,  
She's fine in her shoulders, and thin in her thighs.

She's light in her neck, and small in her tail,  
She's wide in her breast, and good at the pail;  
She's fine in her bone, and silky of skin—  
She's a grazier's without, and a butcher's within."

from the bottom of the girth; the back, again, from behind the top of the shoulder all along the vertebræ, should be well covered; the loins should be wide and thick; the edge-bone, or ridge, along the quarter should form a straight line in continuation with the back, and should also be well covered (which, in a great many animals, it very imperfectly is) to the same level; the twist should be straight down (square), moderately wide and deep, containing a great deal of heavy flesh, and the legs should be well under the animal; there should be a thick coat of mossy hair, not sharp, or what is termed wiry. Altogether, such an animal will have an ease and grace of motion as it walks which is only attained when the whole formation is in perfect harmony. There is, invariably too, a style and grandeur of appearance unmistakeably stamping the 'high caste' Shorthorn. Many well-bred animals will not feed level, but get patchy, which is fatal to them as show animals, however stylish and fashionable in their outline. It is, therefore, indispensable that an animal should lay on flesh uniformly on every part, so as not to spoil the proportion of the several parts. Rough shoulders are always accompanied by heavy open shoulder-blades, and a slack bad girth, deficient through the heart as well as at the top of the plates immediately behind the shoulder. The animal is also sadly deficient in neck vein, being weak and ill-filled where it joins the shoulder-points.

Mr. Housman's description as given in the "History of Shorthorn Cattle," edited by James Sinclair and published by Vinton & Co., is as follows:—

"To describe the modern Shorthorn we begin with the female, and take first that index to breed and character—the head. In the highest type of head the face shortish, broad across the eyes and forehead, generally a little hollow in the outline of the face, and decidedly so between the eyes, finely cut out, like artistic carving in wood or stone, down the face and round the muzzle; the nostrils large and open, cheeks not too fleshy, eyes bright but placid, horns wide set and somewhat flat at the roots, growing outward at first, and as the animal advances in age forming gentle curves which should not be immediately upward. The drooping horn is not generally liked, although it is not always in effect displeasing. A bend forward is considered preferable, and the points may incline either inward or upward. Matched horns are in favour, yet a well-shaped head, with a sprightly outlook, can bear differing horns without disadvantage to the whole effect. The horns and the muzzle should be light coloured and clear, the muzzle a palish buff, without stain of black, the horns yellow in the heifer, but naturally becoming lighter in the cow. Those of some old cows take a pale, sea-green hue with a polished quasi-transparency of surface. A little dark colour at the points is permitted, not commended. Real jet black and chalky white are objectionable horn colours. The throat, often 'leathery' in the well-fed calf and yearling, should be somewhat fine, having but little loose skin under the root of the tongue, without any considerable length of light neck in the mature animal. Almost immediately behind the head, the sides of the neck should begin to swell towards the shoulder, where the flesh should evenly cover the shoulder blades, and hide the prominence of the bones above the arm, technically called the shoulder-points. The ewe-neck is an ugly fault. In very heavily fleshed animals the out-shoulder—or ridge extending to the upper part of the shoulder-blade towards the shoulder-point or junction of the shoulder-blade and lower shoulder bone—has sometimes an immense depth of muscle. This may be considered excessive if the space before it is comparatively bare of flesh, but if that be amply covered, the disturbance of absolute evenness of surface may be pardoned. We find it in many of the best animals. The

shoulder-blades should not be tightly laid in at the top, but should be free to open to the growth of flesh. The fore-rib over the heart, if amply expanded and richly covered with flesh, fills the space behind the out-shoulder and below the crops. The floor of the chest should be proportionately wide and padded with muscle and layers of fat, the fore-flank, or packing immediately behind the hoxter, big enough to fill, or more than fill, the hollow; and the breast sufficiently prominent, substantial, full from arm to arm and evenly shaped forward to the end. The line of the back must be strong and generally straight, yet a slightly heaving line over the chine is permissible if the crops be wide and full; the ribs springing out well to give breadth of back for the beef. A good loin is broad, strong, deeply and evenly covered with flesh, thick at the nearly parallel edges (not rapidly narrowing forward, but square towards the ribs), and in the fatted animal in line with the width of the hips. In fact, on lean animals the hip-bones must be literally covered, not bare, hard, or sharp; each hip 'cleft' and the hollow filled with elastic flesh. This is an important test of



Photo by

Fig. 2.—Shorthorn Bull, "Linksfield Champion."

G. H. Parsons.

Winner of Champion Prize at the Royal Agricultural Society's Show at Lincoln, 1907.  
The property of Mr. F. Miller, Birkenhead.

the quality of the animal, especially in the lean state. The hind-quarters should be wide, well filled, and moderately long, straight on the top, ending squarely, and the tail dropping perpendicularly at a right angle; the thighs thick, and the 'twist' (or filling over the back of the udder) very full; flank heavy; the underline of the body approximating to straight in the heifer, swelling gently as the cow advances in age; the legs straight, wide set, and the fore and hind legs in line. The hair should be abundant and of moss-like softness.

"The characteristics of the bull are those of the cow adapted to difference of sex. The head has a bolder outline, inclining rather to the convex than the concave; the horns are stronger, less bent, and usually shorter than those of the cow, standing out wide from the back of the crown-ridge, and the broad forehead is plentifully covered with hair, wavy or curling; the eyes, prominent and lively, wide-set in large rounded sockets, with a hollow between; the lower part of the face shortish and deeply cut out between the eye and the muzzle, although the outline of the nose may be somewhat high. The swelling outline over the bones surrounding the eyes, as seen in full profile, gives the rounder line of the bull's as compared with the cow's face, and the convexity is often continued to the muzzle. The ideal bull's neck is powerful, massive, rounded, and thickly covered with

hair; but a false judgment, valuing the muscle between the head and body as only so much inferior and undesirable beef, has tended to lower the masculine standard and to make too many bulls more like steers than stock sires. The bull's shoulders and breast should no more show feminine fineness than his hips and hind-quarters should have the width and squareness of those of the cow. In his general character the bull, as compared with the cow, should be as the lion compared with the lioness.

"Great length, in male or female, is generally commended—'long and low' is a frequent term of praise. Length, however, should be in fair proportion to depth and width, and duly divided over the fore, middle, and hinder parts.

"In these particulars the beef type of Shorthorns is principally considered. Between that type and the dairy type, modification (corresponding in the two sexes) is gradual, the most distinctively dairy cow being lighter in the neck, often a little longer and narrower in the face, narrower and not so deep in the chest, and proportionately wider and deeper in the hind-quarters, with large milk veins and udder; the best udder, however, not fleshy or permanently large, but of fine, elastic skin, very considerably shrunk when empty. It should extend well forward, with teats evenly shaped and not too large, set wide apart."

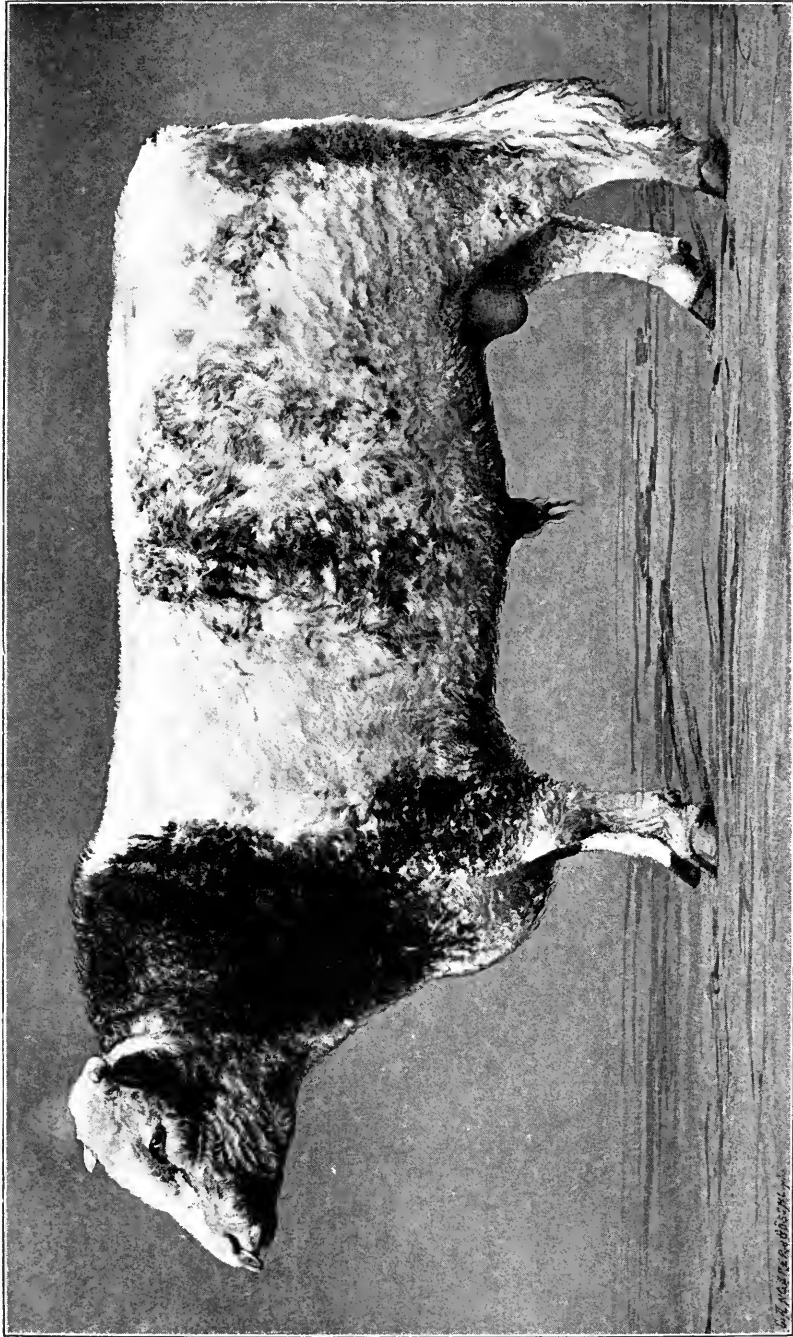


Fig. 2a.—Shorthorn Cow, "Sweetheart."

Champion at the Royal Agricultural Society's Show at Lincoln, 1907.  
The property of Lord Calthorpe, Elvetham Park, Hants.

We have chosen as our new frontispiece a portrait of "Royal Duke," one of the best types of the Shorthorn ever produced. He was calved at Windsor in March 1898, his breeder being Her Majesty Queen Victoria, and he subsequently became the property of His Majesty the King. His sire was Prince Victor, and his dam Rosewater. This grand bull was Champion male of his breed at the Royal Agricultural Shows of 1900, 1901, and 1902, and winner of many other prizes. In 1901 he was Champion Shorthorn bull also at the Royal Dublin, Royal Counties, and Highland Shows. He was sold in 1903 to Mr. F. Miller, for exportation to South America, but unfortunately died on the voyage.

The pre-eminent importance of the Shorthorn has induced us to give also a portrait of the latest Royal Show Champion bull of that breed, in fig. 2.

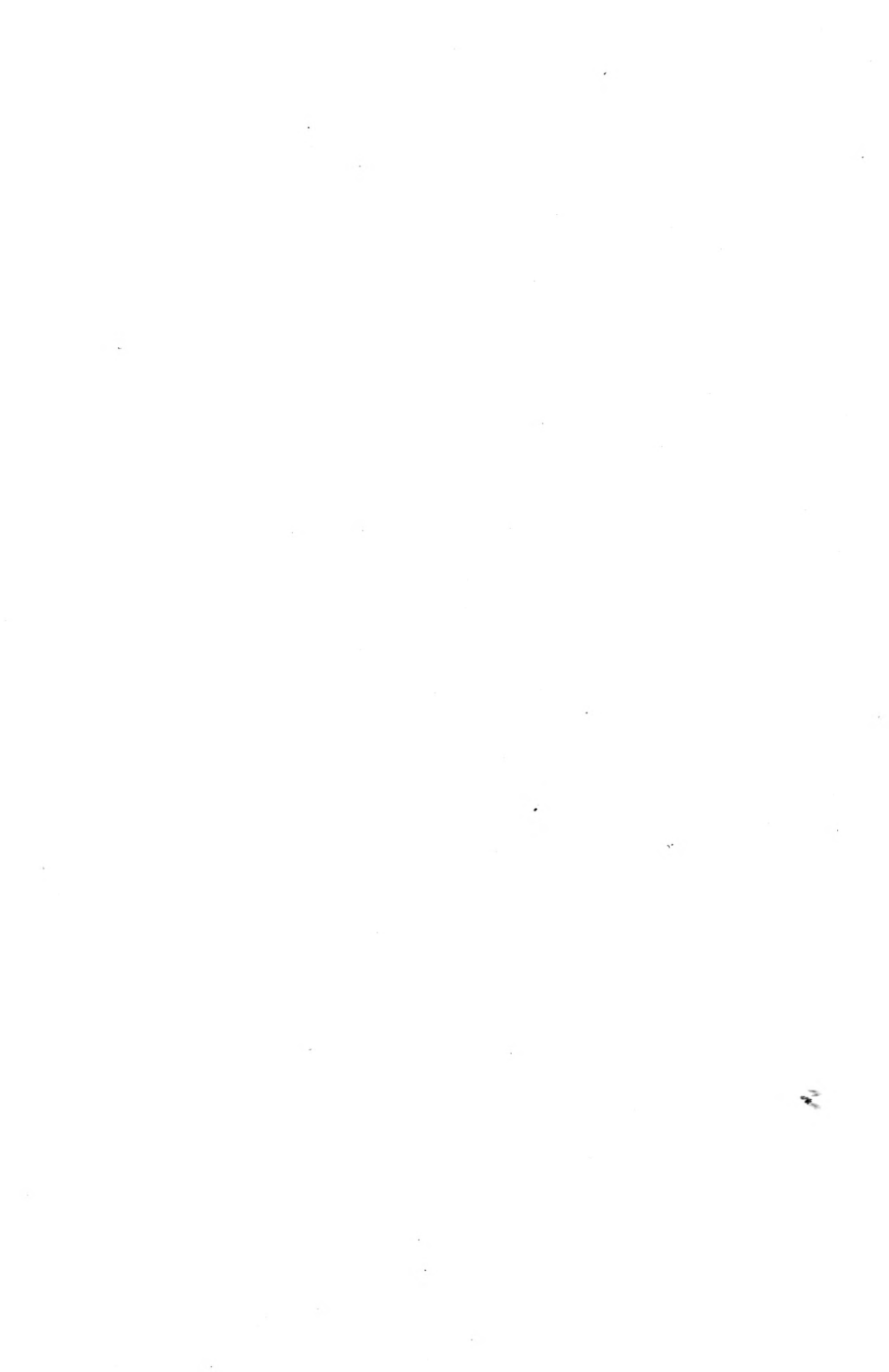


**Shorthorn Bull, "New Year's Gift," 57,796.**

Winner of the Champion Prize as the best Male Shorthorn at the Royal Agricultural Society's Show in 1890.

[This portrait of an admirable Shorthorn appeared as the *Frontispice* to the *Thirtieth and Fourteenth Editions* of "THE COMPLETE GRAZIER,"

*See Preface to the Thirtieth Edition.*]





The first volume of *Coates's Shorthorn Herd-book* appeared in 1822, though the fame of Teeswater cattle as a grand breed was known to travellers as far back as the year 1700, about a hundred years before Robert and Charles Colling, the miscalled founders of the breed, commenced their sales of high-priced stock. This is the most widespread of all the breeds, the best adapted for purely artificial systems of farming, the least fastidious in regard to climate, soil, or lodging.

The Shorthorn breed has, indeed, well earned the epithet ubiquitous—often applied to it, for in whatever part of the world British breeds of cattle have been established, Shorthorns are likely to have been the pioneers. Over most of North America the retention of the term Durhams still points to the original home of the Shorthorns, though Scotch equally with English breeders may claim to have taken an essential part in the development of this favourite breed, and Scottish-bred Shorthorns have demonstrated their quality by carrying north of the Tweed the champion colours from English show-yards.

The Shorthorn Society of Great Britain and Ireland was established at a meeting of Shorthorn breeders held in London on July 1, 1874, at which it was decided to form a society (1) for the purchase from Mr. Strafford of *Coates's Herd-book*, and for the future preparation and publication of a *Shorthorn Herd-book*; and (2) for promoting the general interests of Shorthorn breeders. The main object of the Society is defined to be "to maintain unimpaired the purity of the breed of cattle known as Shorthorns, and to promote impartially the breeding of all the various tribes, families, and strains of such cattle." No bull is eligible for insertion in the Herd-book unless it has *five crosses*, and no cow unless it has *four crosses* of Shorthorn blood, which are, or are eligible to be, inserted in the Herd-book.<sup>1</sup>

THE HEREFORD BREED is larger and weightier than the Devon, to be subsequently described, being generally wider and fuller over the shoulders or chine, and the after part of the rump (*see* figs. 3 and 4).

In his Report in the "Journal of the Royal Agricultural Society" on the cattle exhibited at the Windsor Show, 1839, Mr. William Housman says:—

"Long before the close of the last century, the prevailing colour of the Hereford was red with white face and usually white points—such as the feet and lower parts of legs, the under part of the body, and a line of white along the top of the neck. Old writers describe the red as commonly faint or yellowish, and this paler colour is still often seen; but the Americans have set the example of breeding for dark red, and this has been followed to a certain extent by English breeders. Grey, however, was no uncommon colour from sixty to a hundred years ago, and two grey parents occasionally produced white offspring—a result to this day, when grey Herefords, now scarce, are united.

"When the Royal Agricultural Society of England began its work fifty years ago, red and grey were both orthodox colours, although the

<sup>1</sup> The Lincoln Red is not a new or really distinct breed but is virtually of Shorthorn extraction. It has, however, its own Herd-book with separate classes at the shows. Its uniform red colour has been obtained by selection, and Mr. John Evens has a large herd of them, celebrated for dairy properties.

red was much the more common colour. An American authority, Mr. A. B. Allen, has recorded that in 1841, when he happened to be over in England, he saw at the Society's Show at Liverpool some grey Herefords, and was much struck with their beauty and excellence. The spotted or mottled face was represented by a remarkable bull, 'Maximus,' from the Royal herd at Windsor, first winner in his class at the Battersea International Show, 1862."

In the true-bred Hereford cattle there is no projecting bone in the point of the shoulder, but it regularly tapers off. They have considerable breadth before, and are equally weighty in their hind-quarters. There is a great distance from the point of the rump to the hip-bone; the twist is full, broad, and soft; the arm, as far as the pastern joint, tapering and full, but thin and tapering below the joint. The animals handle remarkably well, and are especially mellow on



Fig. 3.—Hereford Bull, "Pearl King."

Champion at the Royal Agricultural Society's Show, 1907.  
The property of Mr. A. E. Hughes, Wintercott, Leominster.

the rump, ribs, and hip. There is little coarse flesh about them, the offal and bone being small in proportion to their weight, while their disposition to fatten is equal, if not superior, to that of any other breed in the island; they are not, however, specially suited for the dairy. The Hereford cattle arrive early at maturity, and are excellent at the plough or in the team, though seldom worked in their native districts; but it is as fattening stock that they excel. There is a more extraordinary disproportion between the weight of the Herefordshire cows, and that of the oxen bred from them, than is to be found in any other breed. The former are comparatively small, extremely delicate and light fleshed, but are not infrequently the mothers of oxen nearly three times their own weight.<sup>1</sup>

In comparison with the Devon and Sussex, the Hereford breed were

<sup>1</sup> See the "Agricultural Survey of Herefordshire," p. 118, and a Paper by T. A. Knight, Esq., in "Communications to the Board of Agriculture," vol. ii.

not found equally active and hardy in the yoke; but for grazing purposes they are generally considered to be unrivalled.

Some breeders prefer the Hereford to the Shorthorn. There is no doubt of the value of the former as a rapid fattener, and a producer of excellent beef, and when selected carefully it possesses good dairy qualities.

The Hereford breed were formerly in high repute for the draught purposes of the farm. This purpose being, however, nearly set aside, the breed are more prized for their "beef-producing propensities, for which their scale of form, early maturity, and aptitude to fatten, render them highly distinguished." The following, according to Mr. Smith, are the characteristics of the breed:—"The face, mane, throat, the under portion of the body, the inside and lower portion of the legs, and the tip of the tail, are beautifully white; the other parts of the body a rich red, usually darker in the male than the female; the horn is white or light yellow, of a waxy appearance, sometimes tipped with black. The forehead is broad, with spreading horns; those of the bull straight and level with the poll, and of the ox and cow slightly curved, with an upward tendency. The eye is full, yet of a massive expression, denoting the quietness of disposition and temper characteristic of the Hereford, which is of paramount importance to insure the profitable feeding of all ruminating animals. The cheek is fine, the head small in proportion to the carcass, which is long, level, and cylindrical. The hide is thick yet mellow, and well covered with moderately long soft hair, having a tendency to curl. The brisket is prominent, the chest well expanded, and the breed is eminently distinguished for neatness of shoulder, the bone being thin and flat, the kernel full up, the outside shoulder well covered with mellow flesh, the chine good, the loin broad, the hips wide and level, the whole back displaying a straight line, well covered with flesh from the neck to the tail. The twist flank and fore flank are good; the outside thigh is perhaps the most defective part. The whole body is well covered with rich mellow flesh, yielding with pleasant elasticity to the touch. The legs are short, and the bone small, and the whole contour displays great constitution, and exhibits, perhaps, a larger proportion of flesh in proportion to bone, than any other breed."

Mr. E. F. Wells, an authority on points connected with the Hereford breed, makes the following observations on the colour and form of Hereford cattle:—

"Both light and dark colours have been at different periods in general estimation, as the caprice of fashion has ruled, for there is not in reality any sound reason for the rejection or adoption of either exclusively. Mr. Andrew Knight was favourable to light colours—grey or yellowish red—and, as he may not be supposed to have given a preference to them on purely fanciful grounds, he is known to have entertained the opinion that they are the quickest feeders. The darker colours were at one period much approved, and by eminent breeders; among them may be mentioned Mr. B. Tomkins. Mr. Edward Jeffries had also many very dark in his herd, and a bull of his, nearly black,

was exhibited many years ago at Hereford. I believe there is no rule to be considered of at all general application as to one colour being more hardy than another in the breed of Herefords. One reason why light reds or yellows are often less in esteem, may arise from the fact that cattle, when in a state of disease, become lighter in colour. Many persons also entertain an opinion that grey or roan is a colour indicative of delicacy. But, I will ask, is it so considered among the Short-horns? There is at the present time, perhaps, more prejudice about colour than at any former period. On what reasonable grounds is it that the white-faced is preferred to the mottled? This point may be conceded to the former, that a herd of them exhibit a more desirable



*Photo by*

*G. H. Parsons.*

**Fig. 4.—Hereford Heifer, "Princess Beatrice"**

Winner of over a dozen first prizes, including one in the two-year-old class at the Royal Agricultural Society's Show at Lincoln, 1907.  
The property of Mr. W. B. Tudge, Stepaside, Shropshire.

uniformity; but a similarity in size and form would be a higher aim and a more important acquisition; and in the advocacy and adoption of either colour to the exclusion of the other, the faults prevailing in each are often disregarded, and opportunities of reciprocal improvement lost sight of. Mr. Andrew Knight has stated, in one of his publications, that it is probable that the first specimens of the white-faced were imported from the Continent, some cows of that colour having been introduced into the country by a Lord Scudamore, and the supposition seems to be somewhat strengthened by the variety having only become numerous in the last century. Those who are so strongly their advocates should be prepared with some better cause for their preferences than their becoming fashionable. It would also be desirable that we should know what is the cause that of late the buyers of this breed for the purposes of stock are grown so fastidious as not to allow

a tinge of black about the head, neck, and legs, when it can be well ascertained that some of the best and finest specimens of the old Hereford breed have been so marked, accompanied, too, with black noses, against which there is also much prejudice existing among many. I never heard that the eminent breeder Mr. Benjamin Tomkins was in the habit of rejecting a good animal on account of its colour, and, perhaps, there have been none of equal eminence whose attention was less directed to that point. But if he had a preference it was, perhaps, for the grey, a colour he began with and esteemed to the last. If Mr. Tomkins was a disregarder of colour, so also was Mr. John Price. He selected of Mr. Tomkins all the three varieties of colour in Herefords; not that he might possess specimens of each, but finding animals of each variety possessing the form and qualities he was seeking. From this inattention to colour on the part of Mr. Tomkins and Mr. Price, there have gone about many erroneous notions that their breeds were not pure Herefords. Is it likely, I would ask, that either the one or the other, equally tenacious about the pure descent of their herds, and knowing so well the time and difficulty of wiping out a bad stain, would so far commit themselves as to cross too with an alien stock? I consider the idea to have originated entirely from the fact that I have adverted to—their indifference about colour.

“There is, unfortunately for the improvement of Hereford cattle, too little attention paid to the true principles of form—an object which the late Mr. Price long and unceasingly pursued—and it must be regretted that it is not more appreciated in the native county of the breed; the breeders generally contenting themselves with the possession of a few points, which they consider all important, and which give the animal a striking appearance to common observers, without, however, that proportion of parts which it is so desirable to attain. But to go more into detail—I think the formation of the fore-quarter is receiving less attention than it ought, the capacity of the chest in particular, and the ribs which enclose it. The posterior ribs attaching to the loin, the hips, and the rump, seem to occupy the exclusive attention of too many. This also, it is commonly thought, must be accompanied by a very soft touch, in preference to one moderately firm and elastic; it is also considered an advantage if the animal is large—a term often erroneously given to one standing on high legs, without corresponding width and depth of frame. Neither is the malposition of the fore-legs considered of much detriment to the animal; so little attention having been given to the fore-quarter, the advantages or disadvantages of fore-legs crooked or straight have not been properly estimated. There has been, too, an anxious desire to increase the width of the hips, often to the sacrifice of other parts—the middle of the loin and the thigh. An attempt also to get the rump too long leads to a deficiency in the twist, a fault which I fear is rather on the increase with Herefords in general. No animal of the cow kind can be called complete in form, in which the under points are not as well furnished as the upper; and yet how often do we see a striking disproportion! The shoulders in Hereford cattle are liable to but little objection, being for the most

part free from bareness along the front of the shoulder-blade, and from any unnecessary projection of bone at that part commonly termed the shoulder-point. The position of the blade will, of course, vary in obliquity; when that is sufficient, the upper part of the blade will be better united with the chine, and the kernel before the shoulder larger and more developed. The circularity of the pectoral ribs is also greater with such position of the shoulder-blade, and the fore-flank more prominent. Many give a preference to a moderate shortness of the rib. It may often accompany an increased extension of what is (I think erroneously) termed the first rib; but as it represents small intestines, it cannot be supposed to be characteristic of strong constitution; besides, it prevents the flank being placed low enough, which a horizontal line drawn from the elbow will show. The head and neck may be made the subject of a few remarks. In many specimens of good Herefords the neck is placed low in reference to the shoulder, and the head is carried downward in consequence. In cattle, as well as sheep, this form is often accompanied by a fatness of the chine, but it is disadvantageous to an animal when in a pen with others that carry their heads higher. Many of Mr. B. Tomkins's and Mr. Price's had this growth, and I never heard it objected to on any other grounds. There may occasionally be seen some good Herefords, too, with their heads set on abruptly to the neck, rendering the junction of those parts thin and narrow, which is, I think, an indication of too great delicacy, and consequently to be avoided."

The "History of Hereford Cattle," by Messrs. James Macdonald and James Sinclair (published by Vinton & Co., 1886), is an exhaustive and well-written treatise on the popular breed of white-faced cattle. The authors say (page 262):—

"An important characteristic in Hereford cattle is that they carry flesh most heavily on the parts of the frame from which the best meat is cut. Their broad backs are usually loaded with meat of the very finest quality, and the average Hereford carcass is found to have its fat and lean mixed in the most admirable manner. Butchers and consumers alike hold Hereford beef in high esteem. Indeed, the grass-fed Hereford beef enjoys quite an enviable reputation, and brings top figures in the best markets of the country. The perfect mixing of Hereford beef has been notorious for generations, and has frequently been illustrated both by brush and pen. The proportion of lean to fat is exceptionally large, and the whole is juicy, tender, and choicely flavoured.

"Hereford cattle are unsurpassed as graziers. Robust in constitution, quiet in temperament, kindly feeders, and large growers, they thrive and fatten admirably on pasture. The late Mr. Charles Howard of Biddenham, a leading Shorthorn breeder, every year bought a lot of Hereford steers—they are such grand yard cattle! And his experience is corroborated by that of many others who rear and fatten 'white faces.' No variety of cattle will give a better return for the run of a yard, and moderate feeding during winter—say pulped roots, straw, chaff, and a few pounds of cake or grain."

In the "Live Stock Journal Almanac" for 1907 a writer gives the following particulars relating to the progress of the breed in various parts of the world beyond these shores:—"The breed increases in popularity in Ireland, and the pure classes at the Dublin Spring Show are very gratifying. Numerous herds of high merit are in existence in the United States, and probably a renewed inquiry will soon arise from that quarter. Estancieros, in South America, the Argentine, Uruguay, and Chili, have been the chief buyers for export during the past year, and they have taken many. From Australia, too, there is a steady demand, which is likely to grow. The Transvaal has secured several specimens, and other portions of South Africa bid fair to require further representatives of the breed, which does very well in these colonies.

Mr. W. C. Britten, secretary of the Hereford Herd-book Society, informs us that during the year ended September 26, 1906, the export certificates granted numbered 375, as compared with 166 in the preceding year. Of the number exported, 360 went to South America, 8 to South Africa, 3 to New Zealand, 2 to British East Africa, and 1 to the United States." The preponderance of the number for South America is striking.

THE DEVON BREED is found in its purest and best form in North Devon, in the agricultural report of which district the peculiar qualities of the Devon (figs. 5 and 6) are thus described by the late Mr. Vancouver:—

"Its head is small, clean, and free from flesh about the jaws; deer-like, light and airy in its countenance; neck long and thin; throat free from jowl or dewlap; nose and round its eyes of a dark orange colour; ears thin and pointed, tinged on their inside with the same colour that is always found to encircle its eyes; horns thin, and fine to their roots, of a cream colour, tipped with black,<sup>1</sup> growing with a regular curve upwards, and rather springing from each other; light in the withers, resting on a shoulder a little retiring and spreading, and so rounded below as to sink all appearance of its pinion in the body of the animal; open bosom, with a deep chest or keel; small and tapering below the knee, fine at and above the joint, and where the arm begins to increase it becomes suddenly lost in the shoulder; line of the back straight from the withers to the rump, lying completely on a level with the pin, or huckles, which lie wide and open; the hind-quarters seated high with flesh, leaving a fine hair-ham tapering from the hock to the fetlock; long from rump to huckle, and from the pinion of the shoulder to the end of the nose; thin loose skin, covered with hair of a soft and furry nature, inclined to curl whenever the animal is in good condition and in full coat, when it also becomes mottled with darker shades of its permanent colour, which is that of a bright blood red, without white or other spots, particularly on the male; a white udder is sometimes passed over, but seldom without objection.

<sup>1</sup> Arthur Young, secretary to the old Board of Agriculture, describes the thorough-bred Devons as of a bright red, neck and head small, eye prominent, and round it a ring of bright yellow; the nose round, the nostril having the same colour; the horn clear and transparent, upright, tapering, and gently curved, but *not* tipped with black.

“ This description may be considered as a summary of the perfections as to the exterior appearance of the animal. What, under the same head, may be regarded as defects, appear first in the sudden retiring of the rump from behind the huckle to a narrow point backwards; the great space between the huckle and first rib; the smallness of the angle inwards at which the ribs appear to be projected from the spine or backbone, often giving the appearance of a flat-sided animal, and in its being so much tucked up in the girth as to show an awkward cavity between the keel and navel, the line of which, it is presumed, should always be found to hold a position as nearly as possible parallel with that of the back from the withers to the loin. The animal is, however, generally well grown, and filled up behind the shoulder.”

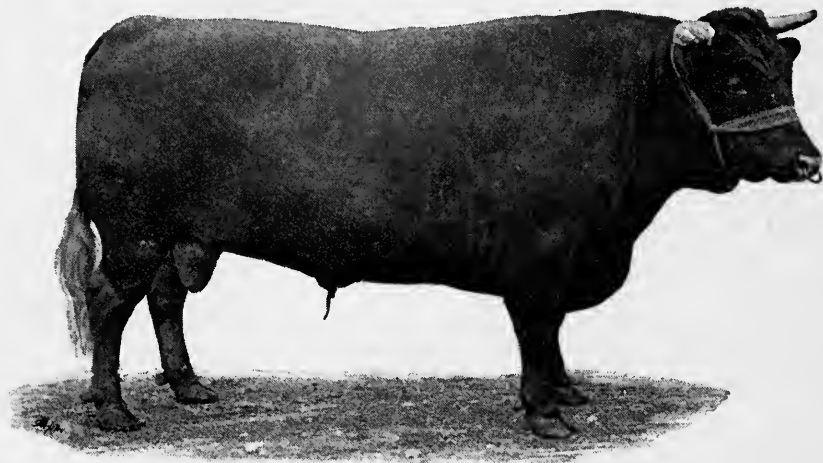


Fig. 5.—Devon Bull, “ Lord Wolseley ” (2063).

Winner of the Champion Prize given by the Devon Cattle-Breeders' Society for the best male in the Devon classes, at the Jubilee Show of the Royal Agricultural Society of England, Windsor, 1889. Bred and exhibited by Viscount Falmouth. Purchased by Mr. W. H. Punchard, Bourton Hall, Totnes, Devon.

The North Devon cattle are highly esteemed, both for feeding and draught, but are not so much valued for the dairy; yet their milk, although deficient in quantity, is of such excellent quality that as much butter can be made from that yielded by a North Devon cow as from that yielded by the breeds which are esteemed better milkers. For all the purposes of labour, whether activity, docility, or strength and hardiness, this breed cannot be excelled. It is said that, on fallow land, it is no uncommon day's work for four steers to plough two acres with a double-furrow plough. The employment of oxen for draught purposes is, however, fast dying out. As the improved practice of agriculture is extended, it brings with it the necessity for the employment of a higher class of animal, as well as of human, labour. The labour of oxen having been found deficient in those qualities required in improved practice; is therefore, as said above, being less



and less used. Although the North Devon cattle do not attain the weight of several other breeds, they fatten early and rapidly, and their flesh is of excellent quality. Many will, with proper care, weigh from forty-five to fifty stones when about two and a half or three years old; and the quality of the meat is unrivalled by that of any other breed.

In South Devon there is a mixture of the pure North Devon stock with a larger breed, of the same kind, called the *Old Marlborough Red*. The latter are said to have descended from the South Molton stock, although at present they differ materially from them in size, and in having a dingy brown or blackish colour at the ears, nose, and round the eyes, or wherever the orange tint is observable in the genuine race.



Fig. 6.—Devon Cow, "Flower 2nd" (9355).

Winner of the Champion Prize given by the Devon Cattle-Breeders' Society for the best female in the Devon classes, and of the Gold Medal presented by Her Majesty the Queen for the best animal in the Devon classes, at the Jubilee Show of the Royal Agricultural Society of England, Windsor, 1889. Bred and exhibited by Sir William Williams, Baronet, of Heanton, Barnstaple.

A cross with this variety is found to fatten more readily than the pure South Devon, and is therefore generally preferred.

The Devons, according to Mr. Smith, are eminently fitted for every hardship, the frame being compact, and the offal light; they have power and great endurance; being "cast in a peculiar mould" they have a degree of elegance in their movement which is not to be excelled. As animal food-producers they are unsurpassed, and in consequence they receive the first attention of the London West-end butchers. A first-rate Devon has a prominent eye, with a placid face, small nose, and elegantly turned horns which have an upward tendency (and curl outwards at the end), as if to put the last finish upon his symmetrical form and carriage. These animals are beautifully covered with silky coats of a medium red colour. The shoulder-points, sides, and fore-flanks are well laden with rich meat, which,

when blended with their peculiar property of producing meat of first-rate quality along their tops, makes them what they are—"models of perfection."

Some object to the North Devon, and class him as a small animal, with the remark, "he is too small for the grazier." In saying this it should always be remembered that the Devon has his peculiar mission to perform—viz., that of converting the produce of cold and hilly pastures into meat, which could not be done to advantage by large-framed animals, however good their parentage. The Devon may thus be designated the "pony of the ox tribe." By their admirers the Devons are to-day termed—and very appropriately—the Rubies of the Western Hills.

The pedigrees of the various animals constituting the "pure-bred Devons" will be found in the "Devon Herd-book." From it may be learnt the fact "that nine-tenths of the present herds of these truly beautiful animals are directly descended (especially in their early parentage) from the old Quartly stock,"—Mr. Francis Quartly being looked upon as the introducer of the new breed.

The Devons make first-class graziers' and butchers' beasts. Although showing their highest condition, and seen in their greatest perfection, in their own habitat, they do well in the more sheltered situations and amongst the richer pastures of more highly cultivated lands. As has been truly remarked of them by the Editor of the "Devon Herd-book" in the pages of "The Field," they bear "change of soil and climate well, thrive where many breeds would starve, and rapidly outstrip others when they have plenty of good pasture." We have said above that they are good butchers' beasts. On this point the same authority remarks:—"As converters of vegetable into animal food, breed against breed, they return as much per acre, or for weight of food consumed, as any. . . . Their beef is of fine quality, and brings a high price in the market. They withstand extremes of temperature. On a poor pasture, from their peculiar build, they are enabled to travel rapidly over the ground without fatigue, and get sufficient nourishment where a heavy Shorthorn or Hereford would starve. The very best of these beasts are the best in the world. . . . The cry has been for the animal that will be the first ready for the butcher, and the Devon has answered it."

In the Journal of the Royal Agricultural Society of England (1890), Mr. Evershed notices the early maturity of the Devons, whether they be of the lesser type of beautiful red cattle which originated among the hills of North Devon, or the heavier breed found on better land in Somersetshire and parts of South Devon. Their Herd-book dates from 1851; but the record of their improved breeding runs back more than a century, and early maturity has been a special aim of their breeders during the whole of that period. The breed is a hardy one, and there is no cossetting and caudling of cattle in the common practice of Devonshire. The young breeding animals are wintered entirely out of doors, in small, sheltered pastures provided with open sheds, to which they can retire at will. He adds that the Devons are specially adapted for pastures of less luxuriant character than some other breeds require.

They will thrive, in fact, on land of moderate quality where some of the heavier breeds would hardly gain flesh without a great deal of artificial aid. But the Devons, with all their merits, would not have won for their owners so much silver plate, if they did not share with the other beef-making breeds the merit of making the best possible use of their food. They are, in fact, fast flesh-forming animals whose meat is of the finest quality.

The following notes were kindly supplied (April 7, 1890), by Mr. John Risdon, jun., Wiveliscombe, Somerset, secretary of the Devon Cattle-Breeders' Society:—

“The Devon Cattle-Breeders' Society has only been in existence since 1884; previously to that date the Devon Herd-book was published by the late Col. Tanner Davy, of Rose Ash, South Molton, Devon. In the latter part of 1883, Col. Davy intimated to my father (Mr. John Risdon), that he intended giving up the publication, and offered to dispose of the copyright of the Herd-book. Negotiations were entered into with the result that it was purchased by Messrs. Hawkes & Risdon, auctioneers of Williton, Somerset. At this time a desire was expressed by a few breeders of Devon cattle to establish a society. Messrs. Hawkes & Risdon thereupon called a meeting of those interested, and the result was that the Devon Cattle-Breeders' Society was formed in January, 1884.

“Colonel Davy published the first volume of the Herd-book in 1851. In that volume there were entries from thirty-seven breeders. Volume two was published in 1854, volume three in 1859, volume four in 1863, volume five in 1869, volume six in 1875, volume seven in 1878, and volume eight in 1881; all these volumes were published by Col. Davy. The eighth volume contained entries from thirty-eight breeders only, so that there appeared to be no appreciable increase in the number of breeders from 1851 to 1881.

“Upon the Devon Cattle-Breeders' Society commencing their work, there seemed to be more widespread interest in the breed. The Society published the ninth volume in 1884. In this volume there were entries from 117 breeders. In 1885, 1886, and 1887, annual supplements were published, giving records of leading sales and shows, and also annual birth-lists, changes of ownership, and deaths in the various herds. Volume ten was published in 1887, and entries were received in this volume from 161 breeders in Devonshire, Somersetshire, Cornwall, Dorsetshire, Berkshire, Hampshire, Staffordshire and Gloucestershire. As the number of entries was so much on the increase, a resolution was passed that the ‘Herd-book’ should be published annually, and the supplement bound with it. This has been carried out since that time; volume eleven was published in 1888, volume twelve in 1889, and the thirteenth volume is now in the printer's hands.

“From these notes it will, I think, be seen that the Devon breed of cattle is increasing very much in numbers and in popularity. Fresh herds are continually springing up in the Midlands and other parts of England, and there is also a good foreign demand. Large numbers

are annually exported for breeding purposes to North and South America, Australia, Germany, and other countries, and they are reported as doing exceedingly well in those parts.

“As to the quality of the beef produced by Devons, it is well known that there can be no better, as is evidenced by beef from this breed being always quoted at the top price in reports of the Smithfield and other markets.

“They are also good as milking cattle. In Dorsetshire and some parts of Devonshire and Somerset, where there are large dairies, well-bred Devons are let to dairy-men frequently at from 11*l.* to 13*l.* per cow.”

At the Plymouth meeting of the Royal Agricultural Society of England, 1890, classes were assigned to the SOUTH DEVONS or HAMS, as was the case at the Exeter meeting in 1850. Although the area, in the southern part of Devonshire, upon which these cattle are reared, is comparatively small, large numbers of them are bred for grazing and dairying purposes. Other breeds that have from time to time been introduced into the South Hams have not thriven as well as the local race. Mr. Wallace in his recently published edition of “Farm Live Stock of Great Britain,” in writing of the South Hams, says:—The cattle belonging to the South Devon division of the breed differ materially in form from the North Devon types, South Devons being larger, coarser, and not so deeply coloured. They perhaps acquired these differences to some extent, and also their greater milking powers, by crossing long ago with Channel Island cattle. This, however, is by no means regarded as an established fact, or accepted among South Devon breeders. These now publish their own Herd-book, the subscribers to Vol. IX. of which (1905) numbered over 250.”

Mr. Eldred G. F. Walker writes as follows in the “Live Stock Journal Almanac” :—“The Red Rubies in 1906 have been in a very transitional state in continuing the policy of merging the beautifully symmetrical North Devon of the Tors with the bigger weight-carrying type, so favoured on the rich undulating lands of Somerset. The union has given more size on the one hand and toned down the coarseness on the other.”

THE SUSSEX BREED (figs. 7 and 8) differs from the Devon in being larger and coarser. When pure bred, the cattle are invariably of a dark-red colour; and those which are marked with a mixture of either white or black are usually crossed with foreign blood. In other respects they are thus described by an eminent breeder,<sup>1</sup> the accuracy of whose judgment has been confirmed by many intelligent graziers :—

“A thin head, and clean jaw; the horns pointing forward a little, and then turning upward, thin, tapering, and long; the eye large and full; the throat clean, and no dewlap; long and thin in the neck; wide and deep in the shoulders; no projection in the point of the

<sup>1</sup> Mr. Ellman of Glynde. See “Agricultural Survey of Sussex,” p. 231.

shoulder, when looked at from behind ; the fore-legs wide ; round and straight in the barrel, and free from a rising back-bone ; no hanging heaviness in the belly ; wide across the loin ; the space between the hip-bone and the first rib very small ; the hip-bone not rising high, but being large and wide ; the loin, and space between the hips, to be flat and wide, but the fore part of the carcass round ; long and straight in the rump, and wide in the tip ; the tail to lay low for the flesh to swell above it ; the legs not too long ; neither thick nor thin on the thigh ; the leg thin ; shut well in the twist ; no fulness on the outside of the thigh, but all of it within ; the squareness behind, common in all long-horned beasts, greatly objected to ; the finer and thinner in the tail the better.

“ Of these points the Sussex beasts are apt to be more deficient in

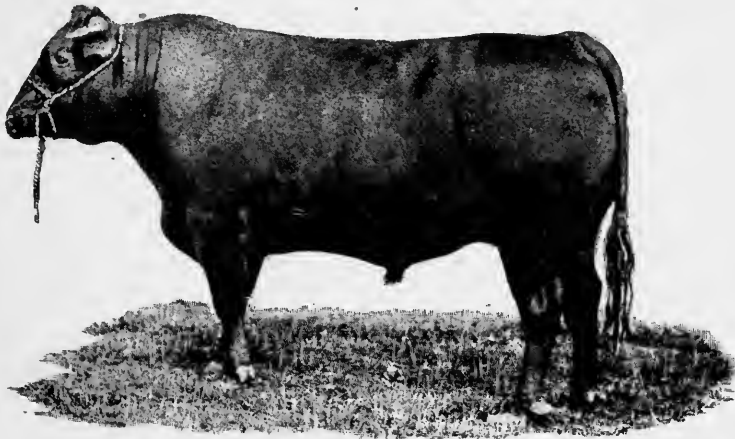


Fig. 7.—Sussex Bull, “Jubilee” (826).

Winner of the Champion Prize given by the Sussex Herd Book Society for the best male in the Sussex classes, at the Jubilee Show of the Royal Agricultural Society of England, Windsor, 1889. Bred and exhibited by Mr. Charles Child, of Park House, Slinfold, Horsham, Sussex.

the shoulder than in any other part. A well-made ox stands straight, and nearly perpendicularly, on small clean legs. A large bony leg is a very bad point, but the legs should move freely, and rather under the body than as if attached to the sides. The horns should push a little forward, spreading moderately, and turning up once. The horn of the Devon, which very much resembles that of the Sussex, but is small and lighter, is longer, and rises generally higher. The straightness of the back line is sometimes broken, in very fine beasts, by a lump between the hips.”

Says Mr. William Housman, in the Journal of the Royal Agricultural Society, 1889 :—

“ Surely, if the Sussex breeders have not yet reduced their bulls to feminine fineness, nor shown them always in the condition of Smithfield steers, their cattle may rest their claims to favour as beef-makers upon the merits of the cows and heifers at the Royal and South-

country Shows and the steers at Smithfield. The grand, massive character of the cows at Windsor, their wide-sprung ribs—a point of structure in which they have greatly improved of late years—their depth of girth, and, owing to increased roundness of rib, their now ample width through the heart, their deep, wide, and projecting breasts, their wide, strong, and thick-edged loins, and the wealth of good flesh upon their backs, with recently improved width across the chine (good ‘crops’), afforded weighty evidence of the competency of Sussex breeders to compete with the world in the production of beef-cattle, whilst the absence of grossness and the presence of style proved that they have advanced far beyond the stage of breeding in which size and substance, valuable in themselves, are unwisely allowed to



Fig. 8.—Sussex Cow, “Elsa” (3214).

Winner of the Champion Prize given by the Sussex Herd Book Society for the best female in the Sussex classes, and of the Gold Medal presented by Her Majesty the Queen for the best animal in the Sussex classes, at the Jubilee Show of the Royal Agricultural Society of England, Windsor, 1889. Bred and exhibited by Mr. W. B. Waterflow, of High Trees, Redhill, Surrey.

put quality and symmetry out of sight. The shapely, sharply-cut head, bright, prominent eyes, and graceful fineness—not over-lightness—of the neck for a short space between the head and ‘neck-vein cushion,’ the ‘clean’ bone of the legs (the term ‘clean’ being understood to express that which is fine, as opposed to coarse, but not too slender), and the level moulding of the frame and superstructure are the ‘guinea stamp.’ They show the genuineness of the breeding. There is, I think, after the initial stages of improvement, this sort of evidence of artistic taste in nearly all the breeds of cattle that come from the hands of the cultured races of mankind—the Anglo-Saxon race, for example. Man begins to improve his cattle for utility, but he has a taste which is consciously or unconsciously brought into exercise, and impressed, as beauty, upon the breeds he develops.

This characteristic of beauty has grown very much in the Sussex cattle of later years."

The Sussex breed found an appreciative chronicler in Mr Evershed, who wrote:—

"I have no desire to magnify the merits of any particular breed, but I think we may recognise the eager search for the best and quickest beef-makers in the rapid advance of Sussex cattle in the favour of the public. I remember them a heavy and a hardy breed, well suited for the rough pasturage of Sussex, and for wintering well in straw-yards on rather short commons, their food chiefly arising from the daily thumping of the flail. Few turnips were grown in those days, and the cattle had to 'rough it' in straw-yards in winter, and in clover, grass, and stubble fields during the rest of the year. They were a big breed, however, and Mr. Youatt was able to describe them, sixty years ago, as having deep, round barrels, straight backs, big bellies, great capacity of the parts containing the heart, lungs, and digestive organs, and wide loins with 'spread-out' hip-bones. They were well ribbed up, too; but they had not the beauty and symmetry of the Devons, and although they made a great weight of beef at three or four years old, or later after their period of service as working oxen was over, the principle of early maturity had not been specially developed in their case as it has been since. At the present time, I believe, no one will dispute that few breeds have attracted more attention than that of Sussex, and that their special merit is acknowledged to be the production of a large amount of beef of good quality, on a moderate amount of food, at an early age. Competition is too keen to admit of any breed getting far ahead of others; but although the Sussex cattle may be equalled as economic meat-makers, they are certainly unsurpassed. The carcass test is not yet applied at the Shows of the Smithfield Club, as it has been for many years at Chicago, Kansas, and elsewhere; but I can quote from the 'Live-Stock Journal' that among the butchers' reports of prize beasts sold at the Show of 1888, a Sussex beast came out best in the proportion of dressed carcass to live weight. The Sussex cattle are still blemished by a certain coarseness and want of symmetry, but their breeders are getting rid of these faults, and they are doing so, one may hope, and obtaining fine bone and mellow skin, and the sweet countenance and beauty of form of the dainty Devons, without sacrificing the large frames and the hardy and robust constitution of the Sussex breed. The first volume of the 'Sussex Herd-book' is dated 1879; but breeders now grown old have told me that their grandfathers, far back in the last century, owned excellent herds of the red cattle of the country, which they had greatly improved. Arthur Young was fond of telling the same story, and his 'Annals' contain interesting accounts of the herds of his friends in Sussex, and of their working oxen and the mountains of beef they made at six or seven years old."

THE LONG-HORNED Leicestershire or Craven cattle are descended from a breed long established in the Craven district, in Yorkshire, where

they produced a stock that soon became remarkable for its beauty and propensity to fatten.

Of this *Canley stock*, Mr. Robert Bakewell, of Dishley, Leicestershire, procured some cows, which he crossed with a Northumberland bull, and thus originated that celebrated race well known as the *Dishley breed*. They were long and fine in the horn, had small heads, clean throats, straight broad backs, wide quarters, and were peculiarly light in their belly and offal. Probably from the effect of domestication and gentle treatment, they were remarkably docile. They grew fat on a smaller proportion of food than the parent stock, but gave less milk than some other breeds. The chief improvement effected seemed to have been their aptitude to fatten early on the most valuable points, and in the superior quality of the flesh.

Notwithstanding the deservedly high reputation, as a breeder, enjoyed by Mr. Bakewell during his life, and that has long attached to his name, the Longhorns have ceased to be general favourites. They are, however, still to be met with, chiefly in Warwickshire and Leicestershire, where they are valued as dairy cattle; more cheese than butter is usually made from their milk, and some cows will furnish from four to five cwt. of cheese each in a season. In the latter half of the last century this stock degenerated and dwindled away in a marvellous manner, considering its prevalence and value at the commencement of that century. This has been ascribed to the system of close *in and in* breeding which was pursued by most of the great breeders of long-horned stock; and many regret it exceedingly. The Durham variety of this breed came to be held in the greatest estimation.

The modern improvements made in the long-horned cattle, since the first attempts of Bakewell, consisted chiefly in the coarser parts being reduced, and the more valuable ones enlarged. The present breed is finer-boned than formerly; the back is straight, wide, and well covered with flesh; the rump is also broad and particularly fleshy on the points, and about the root of the tail. Even when only in store order, the flank is thick and fleshy, and, in every part, the animal handles loose and mellow (*see fig. 9*).

The first volume of the Herd-book was issued in 1878, but during the next twelve years the breed seemed doomed to disappear altogether, and the societies ceased to offer prizes for it. A few breeders, however, remained faithful, and succeeded in saving this interesting race of cattle from total extinction. In 1898 the Royal Society again recognised them at Birmingham, and in 1900 the second volume of the Herd-book appeared. A new Longhorn Cattle Society was formed, and the tide having turned at last, each year has brought new adherents, till at the present time there are upwards of 400 animals registered, and these are scattered widely over the country in about twenty-two herds, while the members of the society numbered thirty-three at a recent date. In 1906 very respectable musters appeared at the only two shows open to them, namely, the "Royal" at Derby, and the "Warwickshire" at Nuneaton. Whether the breed will ever again seriously compete with the Shorthorn or other popular varieties may be doubtful, but to have lost it entirely



would have been a matter of regret to all who feel a just pride in the splendid list of distinct races of cattle possessed by Great Britain, every one of which has its peculiar uses and adaptability to its own environment. In 1906 a Longhorn steer three years old was exhibited at Northampton market, which weighed  $19\frac{3}{4}$  cwt., and dressed 173 stones of 8 lb. Many admirable specimens of the breed have been seen at shows in recent years. The Longhorns are capital butchers' beasts.



*Photo by*

*G. H. Parsona.*

**Fig. 9.—Longhorn Bull, "Fradley Conqueror."**

First in the Younger Bull Class at the Royal Agricultural Society's Show at Lincoln, 1907.

The property of Mr. W. L. Riley, Foleshill Hall, Coventry.

Mr. Housman says of the Longhorn:—Although an area comprising the Craven district of Yorkshire, the southern border of Westmoreland, and that part of North Lancashire which strikes its wedge-end in between Westmoreland on the north-west and Yorkshire on the north-east, was the northern stronghold, if not the fountain-head, of the original breed, Bakewell concentrated the strength of the Longhorn in the Midlands, and a Midland breed it remains to this day, while its old homes in the North have been long occupied by the supplanting Shorthorn, only tradition, a few old portraits, and the boyish recollections of some of the very oldest inhabitants, recalling the glories of the Longhorn.

"The grand old Longhorn, Bakewell's breed," adds the same well-informed writer, "must ever hold the first place in chronological history of the scientific and systematic improvement of British cattle, and long may the type be preserved in its true grandeur and picturesque beauty. The iron constitution, the ample lean flesh, and the abundant

yield of exceedingly rich milk, especially as the Longhorn is reputed a small consumer, should appeal to the pocket as strongly as the wild majesty of the type appeals to the imagination, for these are days in which utility is appreciated, and they are days in which we cannot afford to let slip a robust and hardy breed of cattle like the Longhorn."

THE WELSH BREEDS are, in the present day, classed as North and South Wales—or Anglesey and Castlemartin—cattle. There can be little doubt that they are descendants from the indigenous cattle of Britain; any difference in the type of the two classes being satisfactorily explained by the different management and crosses with other breeds which have been practised in the two districts. Wherever a herd has been managed with any regard to breeding true to the recognised type, the animals are almost entirely black in colour, a little white being occasionally seen about the udders of the cows. Where careful breeding is neglected, a variation in colour to a red or blackish-red commonly occurs; or again the variation may be to a more or less white general colour with black points, closely resembling the semi-wild cattle of Chillingham and Chartley Parks.

Local writers have, at various times, multiplied the number of classes indefinitely, but without further justification than what local fancy, or absence of all care in breeding, may have brought about. It is recorded that wild cattle existed in the more inaccessible parts of the Principality at various times, one writer in the reign of Elizabeth stating that they were then hunted in the more mountainous parts of Pembrokeshire. In all probability these would have been more correctly described as escapes which were roaming in a semi-wild state over the mountainous land. There is much evidence to prove the close relationship of the Welsh to the North Devon and Sussex cattle, which means probably a common origin; these three breeds having nearly all points in common, the exception being that whilst black has been the colour bred to in the Welsh, it has been red in the others. In days now past all three breeds were equally celebrated for their agility and strength, whether in plough or cart.

Good specimens of Welsh cattle (figs. 10 and 11) are exceedingly well proportioned and clean, with easy and elastic movement. Of the suitability of the breed to the locality and conditions there can be no question, nor can there be any question of their merits. They were favourites with Bakewell, who considered them as nearer to perfection, in some points, than any other, except his own improved breed; and many of our graziers inherit his predilection. When fat, the weight of their quarters, at four years old, occasionally runs up to eleven score pounds. They are very quick feeders, and thrive well when brought into rich pastures, making excellent beef, whilst the cows are generally fair milkers.

Disregard of all breeding rules by many occupiers leads to large numbers of nondescript cattle being brought to market, which are commonly referred to as *Runts*; but they are far from being so despicable as might be supposed from the epithet which is applied to them, for they support themselves upon the hardest fare, thriving

where others would starve, and unrivalled as "the cottager's cow." The Welsh Runt, largely grazed in Northamptonshire and other midland counties, is a conspicuous animal at the Christmas fat stock shows, and as an indication of its value from a butcher's point of view, it may be mentioned that of late years several runts have been exhibited scaling upwards of 2,240 lb. live weight, whilst one or two have scaled over 3,000 lb.

Two Herd-books were originally established—the Black Cattle Herd-book for registration of the Castle Martins or South Wales type, and the North Wales Black Cattle Herd-book for the Anglesey cattle. These were amalgamated in 1904 under the auspices of the Welsh Black Cattle Society, a step which, it is hoped, will lead to the obliteration of the

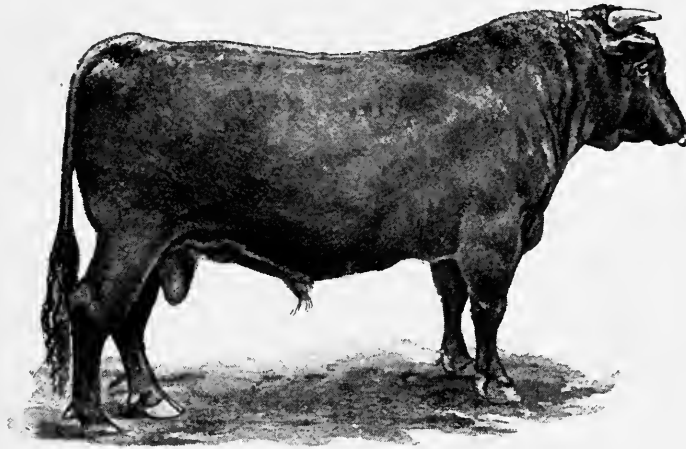


Fig. 10.—Welsh Bull, "Cromwell."

Winner of the Champion Prize given by Lieutenant-Colonel T. Picton-Turbervill for the best male in the Welsh classes, at the Jubilee Show of the Royal Agricultural Society of England, Windsor, 1889. Bred and exhibited by Colonel Henry Platt, of Gorddinog, Llanfairfechan, Carnarvonshire.

many minor varieties of type, and render the breed more uniform. Levelling up to the best type is the great desideratum.

We are indebted to Dr. W. B. Wall, of Pembroke, for some of the foregoing facts.

A writer in the "Live Stock Journal" states that in the rich valley of the Severn and elsewhere numbers of Welsh cattle are annually fattened for the London market, whilst they are also much sought after in the Midlands, because they yield a good return to the grazier for his first outlay, and generally prove more profitable, when slaughtered, than their outward appearance indicates. In addition to their beef-producing qualifications, the cows of the breed are also much appreciated by dairymen, because they are good at the pail, and, if kept well, will yield a fair supply of good butter, whilst they soon put on flesh after their dairy career has ended.

“Welsh cattle,” observes Mr. Housman (*Journal of the Royal Agricultural Society*, 1889), “is a term which covers not only the kindred although differing types of Anglesey and Pembrokeshire, but also those of Montgomeryshire and Glamorganshire; all, in fact, whether unaltered types of the cattle of the aboriginal Britons, or divergent types obtained by selection or by cross-breeding. Some discussion occurred five years ago, when a couple of smoky-faced Montgomeries appeared among the black Welsh cattle at Shrewsbury. Admirers of the black cattle looked upon the red as interlopers; admirers of the red thought them unfairly handicapped in competing

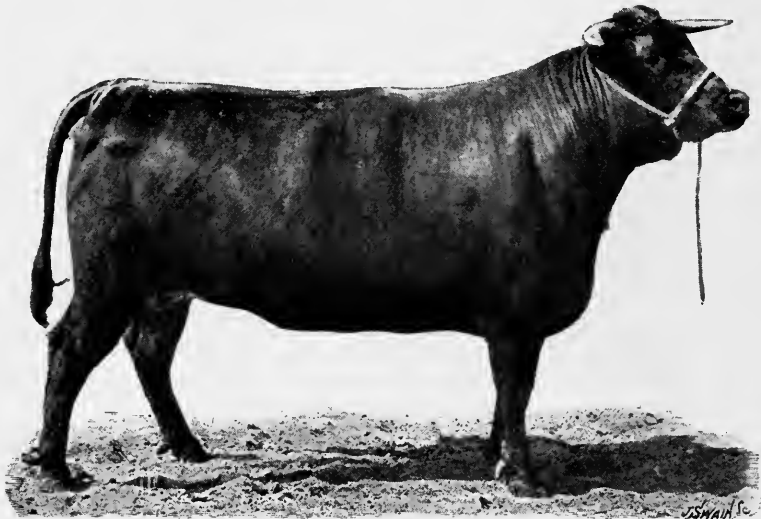


Fig. 11.—Welsh Heifer, “Tudno.”

Winner of the Champion Prize given by Lieutenant-Colonel T. Picton-Turbervill for the best female in the Welsh classes, and of the Gold Medal presented by Her Majesty the Queen for the best animal in the Welsh classes, at the Jubilee Show of the Royal Agricultural Society of England, Windsor, 1889. Bred and exhibited by Colonel Henry Platt, of Gordinog, Llanfairfechan, Carnarvonshire.

with the black, popularly recognised as the cattle of the Principality. Yet, at Cardiff, in 1872, two out of the three prizes in the Yearling Bull Class of mixed Welsh breeds were awarded to red Montgomery bulls.” The Welsh breeds of cattle, he adds, unquestionably possess vast capabilities of both milk and beef production, and their rude health is an important recommendation. “Where hardy, active cattle are required—cattle which can live roughly yet answer to keep and care, grow beef of the first quality and under favouring conditions great in quantity—the Welsh breeds should claim a trial, and they would doubtless prove ready to adapt themselves to districts and countries to which hitherto they have been strangers.”

**RED POLLED CATTLE.**—The Norfolk Polled Breed, known as the

“Norfolk Red Polls,” is by some held to be the original breed of this county; by others to be the result of crossing with the polled Galloway cattle, large numbers of which, a hundred years ago, were imported into Norfolk. It would appear, however, from records recently disinterred from amidst the many connected with the county, that there was a true native breed or race of cattle having some of the peculiarities of the present breed. This original or county breed, if such it was, had, as the favourite colour, a deep blood-red for the body, with a white or a mottled face. They, however, had horns, but these were small, or at least middle-sized, and clean cut. The body was small-boned, but with good round barrel, set on short legs “well loined and thin



Fig. 12.—Red Polled Cow, “Emblem” (2782).

Winner of the Champion Prize given by the Red Polled Society for the best female in the Red Polled classes, at the Jubilee Show of the Royal Agricultural Society of England, Windsor, 1889. Bred and exhibited by Mr. W. A. Tyssen-Amherst, M.P. (Lord Amherst), of Didlington Hall, Brandon, Norfolk.

thighed.” The head was fine. This breed fattened well, taking on meat evenly, and finishing off at three years as freely as other breeds at four and five. It was hardy, and a favourite with the grazier and butcher. The present breed is comely, shapely, docile, and most valuable, without horns, and of a deep red colour.

The “Suffolk Polled Cattle,” known frequently as the “Suffolk Duns,” has, so far as their history can be traced, been a polled breed from the earliest period in the history of the county. The colours usually met with are light dun (hence the above name), red and white, or yellow and white. The hair is fine and silky, the skin thin. The cows are excellent milkers, the head in some being very fine, and the general outline showing indications of thorough breeding.

The steers have, on the whole, good form, the chins and back good;

they are somewhat deficient in fulness in the front, this being narrow as compared with the hind-quarters. The cattle sent out by the best breeders to the various shows are such as prove the value of the breed; few but what are fit, in the words of an eminent breeder from another county, "to go to any show-yard." One peculiarity makes them very valuable to the grazier—their hardiness, which enables them to fit themselves for a wide range of districts, and to thrive in situations exposed to cold winds where other cattle would not do at all. This also helps them to improve even on such poor pasture-lands as would be quite unfitted for the keep of cattle of other breeds.

According to Mr. Henry F. Euren, Editor of the "Red Polled Herd-book," the history of red polled cattle can be carried far back into the last century. Colour was, in the opinion of the old fanciers of Suffolk Polls, a distinctive characteristic. "The red cow established the breed." The red, which is now recognised as the mark of excellence, is a deep rich blood-red. The predominance of the deep red shows plainly the degree in which the old Norfolk breed has affected the Polls, and, on the other hand, the freedom from horns, and from white on the udder and face, is evidence of the persistence of the Suffolk Polled character. The amalgamation of the two varieties—Norfolk Polled and Suffolk Polled—may with certainty be traced from the year 1846. Nevertheless, the breed continued to be without a name until the Royal Agricultural Society, at the Battersea Meeting in 1862, opened classes for "Norfolk and Suffolk Polled" cattle. This designation was thereupon adopted by Norfolk, but it was never accepted by the Suffolk Society, whose practice it has been either to provide classes for "Suffolks," or for "Suffolk and Norfolk Polled." In 1882 it was announced that the breed, having a herd-book, and being distributed far beyond the boundaries of the two counties, would henceforward be known as the "Red Polled," and the register as "The Red Polled Herd-book."

The standard description of Red Polled cattle (*see* fig. 12) is:—

*Essentials.*—*Colour*: Red. The tip of the tail and the udder may be white. The extension of the white of the udder a few inches along the inside of the flank, or a small white spot or mark on the under part of the belly by the milk veins, shall not be held to disqualify an animal whose sire and dam form part of an established herd of the breed, or answer all other essentials of the "standard description."

*Form*: There should be no horns, slugs, or abortive horns.

*Points of a Superior Animal.*—*Colour*: A deep red, with udder of the same colour, but the tip of the tail may be white. Nose not dark or cloudy.

*Form*: A neat head and throat; a full eye. A tuft or crest of hair should hang over the forehead. The frontal bones should begin to contract a little above the eye, and should terminate in a comparatively narrow prominence at the summit of the head.

As a dairy cow the Red Polled is rapidly rising in public estimation. For three or four years a daily record has been carefully kept of the yield of milk from Mr. Garrett Taylor's herd, at Whitlingham, one of

the largest herds of Red Polls in the kingdom. The record shows that the milk is only less rich in butter fat than that of the Jersey or Guernsey, whilst, as a rule, the cows yield a much larger quantity, taking the year round. At the same time they do not cost more to keep than the Jerseys, and commonly carry their milk from one calving almost to the date of calving again. Mr. Taylor remarks :—

“Red Polled cattle have been greatly appreciated in America as well as in England on account of their being hornless. A breeder of race-horses in the Midlands has bought several from me for the purpose of turning them out to graze with brood mares on account of their possessing that quality. A still further example of the advantage of polled cattle, especially when on long journeys, is seen in the Irish cattle imported to England, the horns of which have been sawn or cut off the better to perform the journey. They are also more saleable dishorned in our market, as they do not horn one another in the yards when grazing, though the operation of dishorning must seriously affect them for a time.”

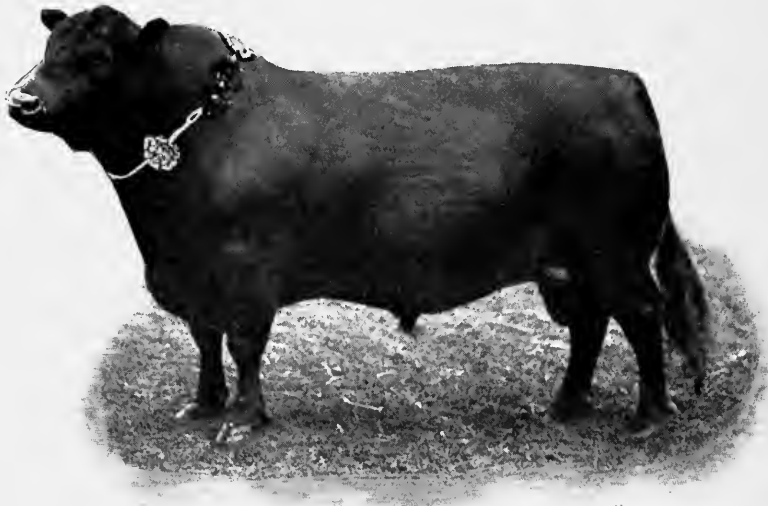
Good dairy properties, high quality of flesh, and a ready tendency to fatten, in cattle of medium size, not too large for poorish pasture, and hardened to a coldish climate, are highly valuable characteristics, and, as Mr. Housman points out, make the Red Polled breed suitable for conditions of existence which would be very unfavourable to many of the heavier breeds.

**ABERDEEN-ANGUS.**—The Polled Angus or Aberdeen is now the prevailing breed of cattle in the wide triangular-shaped area of country which lies to the north-east of a line drawn from Dundee to Nairn. Each of the counties of Forfar and Aberdeen seems to have had from time immemorial its polled cattle, the one being termed the Angus Doddies and the other the Buchan or Aberdeen Hummlies, and from both these races the present improved breed seems to have sprung. One of the great improvers of the breed was Mr. Hugh Watson of Keillor, Forfarshire, who has been termed the Colling of the Angus breed. The approved colour of the Aberdeen-Angus is black, but some animals are more or less marked with white. The white markings, however, that occasionally crop out, and the red colour which sometimes marks an animal of pure breeding, are instances of atavism. If a red calf is dropped in any first-class herd it is invariably sent to the butcher, and is never used for breeding purposes. The head is fine, the carcass round and low, the legs are short and the shoulders full.

These cattle (figs. 13 and 14) attain to a large size, with heavy weight. As compared with the Galloways, they are finer in the bone, softer and silkier in the hair, and generally shorter in the legs.

“The Aberdeen-Angus of the present day,” remarks Professor Wallace in his “Farm Live Stock,” “occupies among Scotch cattle very much the same position as the Devon does among English breeds for equality of flesh, refinement of type, perfection of symmetry, and, it might be added, for the excellent flavour of its marbled beef; yet it

must not be forgotten that these qualities, like the qualities of all British breeds, however distinct and however permanent they may be, are the results of the commingling of blood of various kinds. No single breed is pure if we go back for but a few generations. It is recorded that, less than 100 years ago, crossing was carried on with Ayrshire, Guernsey, Fife,\* Shorthorn, and Galloway cattle. How much of this blood has been maintained in the best animals of the present day is a matter for conjecture. It is true that the well-known attempt of Lord Panmure to introduce a Galloway cross was not



*Photo by*

*G. H. Parsons*

**Fig. 13.—Aberdeen-Angus Bull, "Idelamere."**

Gold Medal bull at the Show of the Royal Agricultural Society, 1907, and winner of a first prize at the Show of the Highland Society, 1907.

The property of Mr. T. H. Bambridge, Eshott Hall, Northumberland.

attended with success; but, on the other hand, there is good reason to believe that the very extensive and successful use of Shorthorn bulls in breeding grazing cattle for the southern markets led to the incorporation of Shorthorn qualities into the breed during the early years of its improvement. At times very distinct Shorthorn characters appear by atavism in polled cattle of good blood and long pedigrees, and disappear in the next generation."

The following details concerning this breed are quoted from Messrs.

\* The Fife horned breed is extinct. They were large black cattle, rather slow at coming to maturity at an early age, but unsurpassed as grazers after they were three years old.



Macdonald and Sinclair's "History of Polled Aberdeen or Angus Cattle":—In general form a model polled animal differs considerably from a model Shorthorn. Both should be lengthy, deep, wide, even, proportionate and cylindrical. The polled animal, however, should be more truly cylindrical in the body than the Shorthorn. Its points should be more quickly rounded off; or, in other words, the frame of the polled animal is not so fully drawn out to the square as that of the Shorthorn. The admirers of the breed claim for it valuable natural properties not found to an equal extent in any other breed: and they fear that should the breed lose its characteristically natural appearance it may also lose its superiority in those valuable properties—"the genuine article should always bear its trade-mark." Careful improvers of the breed are specially particular as to the hind quarters. While they aim at developing long, level, thick, deep quarters, they also strive to retain the rounded appearance which was originally one of the dominant characteristics of the breed. The head of the Polled male should not be large, but should be handsome and neatly set on. The muzzle should be fine; the nostrils wide; the distance from the nostrils to the eyes of only moderate length; the eyes mild, large and expressive; the poll high; the ears of fair size, lively, and well covered with hair; the throat clean, with no development of skin and flesh beneath the jaws, which should not be heavy; the neck pretty long, clean, and rising from the head to the shoulder-top and surmounted by a moderate crest which contributes to masculine appearance—a desirable point in a bull. The neck should pass neatly and evenly into the body, with full neck vein. The shoulder-blades should lie well backwards, fitting neatly *into* the body, and not lying awkwardly *outside* it: they should show no undue prominence on the shoulder-top, on the points, or at the elbow. An upright shoulder in cattle is generally accompanied by a light waist—an important, and in all breeds a much too common defect. The chest should be wide and deep, so as to give plenty of room for lung-development. The bosom should stand well forward between the forelegs, and underneath should be well covered with flesh and fat. The crops should be full and level, with no falling-off behind them; the ribs well sprung, springing out barrel-like, and neatly joined to the crops and loins; the back level and broad; the loins broad and strong; the hook-bones not too wide—narrower than in an average Shorthorn; the quarters long, even, and rounded, with no hollow from the hooks to the tail; the tail should come neatly out of the body, not too far up the back, and not higher at the root than the line of the back. A high tail-head was to some extent characteristic of the ancient Polled breed, but it is one of the defects that are being gradually removed by the more scientific systems of breeding now pursued.

Some good Polled cattle, too, have been found to show a development of soft worthless flesh and fat on the rounds behind; but that defect, which is disliked very much, is also almost obliterated. The tail should hang straight down, close to the body all the way till it comes near to the level of the flank. On both sides of the tail the quarters should turn away in a rounded manner, swelling out downwards, and

ultimately passing into deep thick thighs. The twist should be full, and the hind legs set well apart, and not detached from the body until the level of the flank is reached. The flank should be full and soft, so that a good handful may be got out of it.

The bottom line should be as even as the top and side lines; and the bones of the legs fine, flat and clean, with plenty of muscle and flesh above the knees and on the fore legs.

The body should stand neatly and gracefully on the legs, and when the animal is stationary, the fore legs should be perfectly straight, and the hind legs very slightly bent forwards below the hock. All over the frame there should be a rich and even coating of flesh. Even the hock bones, and other prominent parts, should be well covered; and above all, there should be no patchiness—no hollows, and no rolls of hard flesh, with spaces of soft useless fat between them, such as are always found in a patchy animal. Except in rare cases, the skin is fairly thick, but soft and pliable; it ought to be so free over the ribs that one could fill one's hand with it. The hair is, as a rule, not long, but fairly thick-set and soft; and in the best animals shows two growths, or rather two lengths—one short and thick, and the other longer and thinner. When walking, a good animal of the breed presents a very compact, graceful, and symmetrical appearance. Indeed, it is fairly enough claimed for the breed that, in these and in some other respects, it has hardly any equals and no superiors.

The above description refers more correctly to bulls than to cows. The latter, of course, differ considerably in character. The head is much finer, the neck thinner and cleaner, with no crest; the shoulder-top sharper; the bone altogether finer; the skin not quite so thick; the udder large, and milk-vessels large and well-defined. In appearance, as well as in other characteristics, the Polled Aberdeen or Angus breed differs substantially from the Polled Galloway race. The former has lived under a dry, cold climate, and has been fed in the house during a large part of the year. The latter has its home in a moist climate, and has spent much more of its time in the open fields. The differences between the two are just such as might be expected from their different conditions of life.

The Galloway, as already noted, has a thicker skin and stronger coat of hair, and has altogether a more shaggy appearance than the northern Polled cattle, and does not mature quite so quickly. It is claimed that the northern Polls surpass all other races of cattle in the production of beef. On that point there is, of course, considerable difference of opinion; for at the present day, when the beef-producing properties of our other leading breeds, notably the Shorthorn and Hereford, have been developed to so high a degree, it could not be expected that with anything like unanimity any one breed would be accorded the premier position. Be that as it may, we think the Polled Aberdeen or Angus breed may safely be said to be inferior to none as all-round beef cattle, and superior to all others in some respects.

The superiority over most other breeds, for the butcher's purpose, lies mainly in the excellent quality of beef, and in the high percentage

of dead-meat to live-weight. As a rule, the beef of the northern Polls is very well mixed, and contains a greater proportion of compact, finely grained flesh, and less soft, coarse fat, than most other kinds of beef. Inside, the carcass is usually well lined with fat of the finest quality; while in the density and quality of the carcass itself, the breed may fairly enough claim the premier position among all our leading breeds of cattle.

Some place the small Devon breed alongside, if not even before it, in this respect; but with that exception we do not think that any other breed in the British Isles will on an average yield so high a percentage of dead-meat to live-weight. In butcher's phraseology, it "dies" well and "cuts up" admirably.



*Photo by*

*G. H. Parsons.*

**Fig. 14.—Aberdeen-Angus Cow, "Juana Erica."**

Gold Medal Cow at the Royal Agricultural Society's Show at Lincoln, 1907.  
The property of Mr. J. E. Kerr, Harviestoun Castle, Dollar, N.B.

In all the leading fat stock markets in the country the breed is held in high estimation, and, as a rule, commands the very highest prices—in fact, generally a higher price in comparison to its size and live-weight than any of the other leading breeds. This is especially the case at the great Smithfield Christmas market in London, where the plump, compact Polls from the north never fail to find a ready sale at the highest quotations.

The late Mr. M'Combie of Tillyfour, formerly M.P. for West Aberdeenshire, who began his herd in 1832, did more than any other man to give the Aberdeen-Angus breed the high celebrity it has attained as a beef-producing race. When the rage for Shorthorns was at its height, the polled breed was threatened with extinction, but he and other devoted admirers of the native race remained steadfast to their first love, with the most satisfactory results to the once discarded black skins.

The Very Rev. Dr. John Gillespie describes the Aberdeens as hardy in constitution, quiet and docile in temperament, and very prolific. The milk given by many of them is large in quantity and rich in quality, but as milkers they vary a good deal. In colour they are now almost universally black, but at one time many of them were brindled and red, and occasionally animals of these colours are still found. Their hair is smooth and silky, and it has a much more glossy appearance than that of the Galloway, which otherwise they much resemble. They come early to maturity, grow to a large size, and are easily finished for the fat market, the quality of their beef being unsurpassed. Of all the varieties of cross-bred cattle, there is none more satisfactory and remunerative to the feeder than the cross between the Aberdeen-Angus and the Shorthorn. It grows to a large size, shows a great aptitude to fatten, and, when it has been killed, the fat and lean are found to be distributed in the carcass in most desirable proportions.

Many good herds of this breed have been established in England of late years with great success—and this is a further proof of the high esteem in which they are now held.

THE GALLOWAY BREED (*see* fig. 15), or, as it is often termed, the Polled Scots, derived its appellation from the south-western counties of Scotland, in which these cattle are chiefly reared, and whence vast numbers were formerly sent to Norfolk and other English counties, to be fattened for the markets. In general they are black, or dark brindled brown. They are without horns.

The Very Rev. Dr. John Gillespie, Editor of the "Galloway Herd-book of Great Britain," and a well-known authority, states that the province of Galloway has for several centuries been confined to that south-western corner of Scotland which comprises the Stewartry of Kirkcudbright and the county of Wigtown. But originally Galloway included, in addition, Dumfriesshire, Ayrshire, Renfrewshire, and part of Lanarkshire, and may be described generally as having comprised that extensive tract of country lying to the west of the main line of the Caledonian Railway from Carlisle to Glasgow. Until towards the close of the last century, the Galloway was the only breed of cattle kept in the wider of these two districts, once called Galloway. The Ayrshire has now completely supplanted it in the county of that name, as well as in Renfrewshire and Lanarkshire; it has also driven it almost entirely from Wigtownshire, where the dairy system extensively prevails, and in the Stewartry of Kirkcudbright and Dumfriesshire that fashionable milking breed has largely taken its place. Serious inroads have been made by the Shorthorns upon an old stronghold of the Galloway in the eastern division of Cumberland. It is almost exclusively as beef-producers that the Galloway cattle are distinguished, for their milking properties are not extraordinary. They are very hardy in constitution, being covered by a profusion of black hair, which forms an excellent protection to them in their native climate, which is cold and moist. In the Smithfield and other leading markets Galloway beef is ranked among "prime Scots." The excellent cross—in great

favour with butchers under the name of the "blue-grey"—between the Galloway cow and the Shorthorn bull yields a beautifully mixed flesh, and the infusion of Shorthorn blood induces earlier maturity than is characteristic of the pure Galloway. The cross between the Galloway bull and the Ayrshire cow is also a good hardy beast; many farmers in Galloway who combine dairying (using Ayrshire cows) with the rearing and feeding of cattle, adopt this cross, with results which, climate and soil being considered, are usually regarded as satisfactory.

The following statement of the characteristics of a typical animal of the Galloway breed was drawn up by the Council of the Galloway Society of Great Britain in 1883:—*Colour*, black with a brownish tinge. *Head*, short and wide, with broad forehead and wide nostrils: without



Photo by

G. H. Parsons.

Fig. 15.—Galloway Bull, "Chancellor of Ballyboley."

Champion at the Royal Agricultural Society's Show at Lincoln, 1907.  
The property of Mr. John Cunningham, Ballyboley, Tarbreach, N.B.

the slightest symptoms of horns or scurs. Eye, large and prominent. Ear, moderate in length and broad, pointing forwards and upwards, with fringe of long hairs. Neck, moderate in length, clean, and filling well into the shoulders; the top in a line with the back in a female, and in a male naturally rising with age. Body deep, rounded, and symmetrical. Shoulders fine and straight, moderately wide above; coarse shoulder points and sharp or high shoulders are objectionable. Breast full and deep. Back and rump straight. Ribs deep and well sprung. Loin and sirloin well filled. Hook bones not prominent. Hind-quarters long, moderately wide, and well filled. Flank deep and full. Thighs broad, straight, and well let down to hock; rounded buttocks are very objectionable. Legs short and clean, with fine bone. Tail well set on and moderately thick. Skin mellow and moderately

thick. Hair soft and wavy, with mossy undercoat; wiry or curly hair is very objectionable.

From time immemorial the Galloways have been polled or hornless. In the very earliest notices of the breed there is no allusion to the presence of horns. It has always been an unvarying test of the purity of a Galloway that it has not the slightest trace of a scur or horn. Any so-called Galloway presenting such an appearance should be unhesitatingly rejected as impure.

The late Mr. James Biggar, writing in the "Live Stock Journal," said:—  
"Galloway cattle have qualities which specially fit them for improving the stock on the vast ranges of the West. They are, first, possessed of great hardiness and vigour of constitution, which specially fit them for standing a severe climate. Second, they are without horns. Third, they are uniform in type, of a deep symmetrical and blocky character, on short legs, with good skins, and producing the largest proportion of the most valuable meat. And, fourth, they possess the power of transmitting these qualities to their produce in a most marked degree; so much so, that when a Galloway bull is crossed with any horned breed, nearly 90 per cent. of the produce will be black, and 95 to 100 per cent. without horns. Although they have been little more than introduced in the West, the concurrent testimony on all the above points is very strong, and a selection of Galloway cattle would probably bring a higher average price west of the Mississippi than any other breed. When the writer was in America in the autumn of 1885, he inspected a herd of Galloways established near to Kansas City, of which a number had gone from his own herd. He was greatly astonished at the remarkable condition of the cattle. He found 100 cows and heifers in a pasture of 160 acres, where they had been for twelve months. They had got hay in winter, but no artificial food, and were all very fat; many were quite in fat show condition, and all were remarkably smooth, plump, and full of flesh."

THE HIGHLAND OR WEST HIGHLAND BREED of horned cattle (*see* figs. 16 and 17) is reared in the Western Highlands of Scotland. The horns are large, sharp-pointed, and upturned, and the colour is generally black, brindled, or dun. The hides are thick, and covered with long soft hair of a close pile, which nature seems to have intended as a protection against the severity of the climate under which these cattle are bred, for they lose much of this distinction when reared in a southern country. In other respects they are not unlike the Galloway breed, many of whose best qualities they possess, particularly their hardiness of constitution, beautiful symmetry, and finely-flavoured flesh. Their straight and level backs, their round and deep carcasses, and the quantity of good meat which they yield in proportion to their size, are most valuable points.

Of this breed there are several distinct varieties. The principal are the *Kyloes*—the aboriginal breed of Scotland, and existing in their greatest state of purity in the Isle of Skye. In Perth, and Ross, and Argyle, the pastures will carry a larger breed, and it is in the last-named county

that the real *West Highlander* is to be seen in full perfection. The broad back, the short legs, the fine muzzle and the black-tipped horn, the quality of the meat, and the quickness of fattening, will sufficiently distinguish him. From an artist's point of view, they are the most picturesque of cattle, admirably in keeping with their wild, mountainous home. The *North Highlanders*, from the Orkneys, and Caithness and Sutherland, possess similar excellent points, but the exposed country which they inhabit and the scanty pasturage materially lessen their size. Too many of them are comparatively neglected on account of their diminished bulk.



Fig. 16.—Highland Bull, "Lord Clyde."

Champion at the Highland Society's Show in 1906.

The property of Mr. Ian Bullough, Meggernie Castle, Perthshire.

It is yet thought<sup>1</sup> that there are really only two distinct classes, namely, the West Highland, and the Highlander or mainland Highlander. The former of these classes (termed the *Kyloe*) is, as above mentioned, found in its greatest purity in the Western Isles of Scotland, to which it no doubt was at first confined. The normal colour of the *Kyloe* was black, and in the recollection of people who are still alive no other colour was known in the leading folds of the West. The pure *Kyloe* seems also to have been smaller and shaggier than the Highlander, but whether this was a distinctive feature of this class of the breed, or whether it arose from the cattle being kept in a purer state and more

<sup>1</sup> Highland Herd-book, 1885.

exposed to the elements than the mainland cattle, it is not easy to say. It is only within comparatively recent years that the colours now so much in favour with breeders became common among the West Highland cattle, and the first animals possessed of such colour seem to have been introduced from Perthshire.

The West Highland cattle are, says the Very Rev. Dr. John Gillespie, indifferent as dairy cows, but their milk, though small in quantity, is peculiarly rich in quality. The calves, which are almost universally suckled by their mothers, are kept under cover during their first winter, but afterwards they are left out in all sorts of weather, for which, from



Fig. 17.—Highland Heifer, "Lady Flora:

The Property of the Right Hon. the Earl of Southesk, K.T.

their vigorous constitution and hairy covering, they are peculiarly adapted. When one or two years old they are transferred to the lowlands, where they are grazed until they are fit for the fat market. In a well-bred specimen the head is short, with a fine muzzle; the forehead broad, and overhung with long shaggy hair; the eye prominent; the horns are expansive and gracefully curved; the breast is full and broad, and the chest deep; the ribs are boldly arched; the legs short and muscular; the back is straight, and the body covered with a profusion of shaggy hair.

THE AYRSHIRE BREED (*see* figs. 18 and 19) ranks deservedly high in the estimation of dairy farmers. The most approved form of the best milkers is thus described by Mr. Aiton:—

“Head small, but rather long and narrow at the muzzle; the eye



small, but quick and lively; the horns small, clear, bended, and the roots at a considerable distance from each other; neck long and slender, and tapering towards the head, with little loose skin hanging below; shoulders thin; fore-quarters light and thin; hind-quarters large and capacious; back straight, broad behind, and the joints and chine rather loose and open; carcass deep, and the pelvis capacious and wide over the hips, with fleshy buttocks; tail long and small; legs small and short, with firm joints; udder capacious, broad, and square, stretching forwards, and neither fleshy, low hung, nor loose, with the milk-veins large and prominent; teats short, pointing outward, and at a consider-

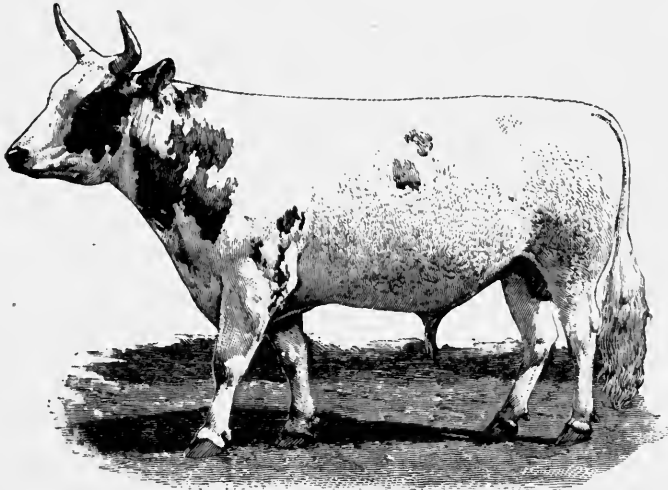


Fig. 18.—Ayrshire Bull, "Cock-a-Bendie" (1204).

Winner of the Champion Prize given by the Ayrshire Cattle Herd Book Society for the best male in the Ayrshire classes, at the Jubilee Show of the Royal Agricultural Society of England, Windsor, 1889. Bred and exhibited by Robert Osborne, of Drumjoan, Ochiltree, N.B. Considered a model of type and colour for an Ayrshire.

able distance from each other; the skin thin and loose; hair soft and woolly; the head, horns, and other parts of least value, small, and the general figure compact and well-proportioned. There is to the present day much dispute with regard to the origin of the Ayrshire cow."

At the Dairy Conference, 1889, held in the South-west of Scotland, Mr. Robert Wallace, Auchenbrain, read a paper on "Ayrshire Cows as Milk Producers," in the course of which he gave the following as the points of a good or model Ayrshire cow: Head medium size, forehead wide, nose fine between muzzle and eyes; muzzle wide; eyes full and lively, with a docile expression when not disturbed; neck long and straight from shoulder to head, gracefully tapering from brisket upwards, free from loose skin underneath, and fine at its junction with the head; shoulders thin at top; brisket light; the whole forequarters thin in front and gradually increasing in depth and width backwards;

back short and straight ; spine well defined, especially at the shoulder ; ribs well arched and deep at the flank ; hind quarters long, broad, and straight ; hook bones wide ; thighs deep and broad ; tail long and slender, and set on at a level with the back ; legs short, the bones fine, with nice broad firm joints ; milk vessel or bag large, extending well forward ; hind part thick and firmly attached to the body, the sole or under surface nearly level, with teats from 2 to  $2\frac{1}{2}$  inches in length, about equal in thickness, round at the very point like your finger, rather than bottle-soled, soft and elastic to the touch like a kid glove, well set and hanging perpendicularly ; their distance apart at the sides should be equal to about one-third of the length, and across to about one-half of the breadth ; the milk veins large and well developed, skin soft and elastic. In colour, a distinct brown and white. An Ayrshire cow should move gracefully and carry her head nice and high. These combined points give a wedge-like shaped appearance to the animal.

The following, from a report to the Ayrshire Agricultural Association, gives the "points" which indicate superior quality in the Ayrshire dairy cows :—

"Head short, forehead wide, nose fine between the muzzle and eyes, muzzle moderately large, eyes full and lively, horns widely set on, inclining upwards, and curving slightly inwards.

"Neck long and straight from the head to the top of the shoulder ; free from loose skin on the under side, fine at its junction with the head, and the muscles symmetrically enlarging towards the shoulders.

"Shoulders thin at the top, brisket light, the whole fore-quarters thin in front, and gradually increasing in depth and width backwards.

"Back short and straight, spine well defined, especially at the shoulder, the short ribs arched, the body deep at the flanks, and the milk-veins well developed.

"Pelvis long, broad and straight, hook-bones (ilia) wide apart, and not much overlaid with fat, thighs deep and broad, tail long and slender, and set on level with the back.

"Milk-vessels capacious and extending well forward, hinder part broad and firmly attached to the body, the sole or under surface nearly level, the teats from two to two-and-a-half inches in length, equal in thickness, and hanging perpendicularly ; their distance apart at the sides should be equal to about one-third of the length of the vessel, and across to about one-half of the breadth.

"Legs short, the bones fine and the joints firm.

"Skin soft and elastic, and covered with soft, close, woolly hair.

"The colours preferred are brown, or brown and white, the colours being distinctly defined."

Mr. Primrose McConnell, writing in the "Live Stock Journal Almanac," thus records his experience of Ayrshire cows: "They will cost £15 per head to lay in; will cost £15 per annum to feed; will yield about £20 of produce, which will be over 600 gallons of milk per annum, showing 3·5 to 4 per cent. of fats, 12 to 15 per cent. of cream,  $12\frac{1}{2}$  per cent. of solids, and 200 lb. of butter per

annum ; and she will sell when fat at £12 to £15. Her hardiness will enable her to live and to thrive in exposed situations and on scanty fare ; while, when taken south, if she gets plenty of good water to drink, and is not pampered with too much good food, she will do better and will repay the outlay and trouble."

In his book "The Farm and the Dairy," Professor Sheldon remarks that as milk-producers the Ayrshires are very superior, though their milk is not specially rich like that of the Jerseys and Guernseys. "Some Ayrshire cows," he adds, "have yielded as much as a thousand to twelve hundred gallons of milk in a year, and this yield, considered in relation to the size of the animal, is quite wonderful. Their milk appears to be specially adapted for cheese-making purposes, being rich in casein ; but I once had an Ayrshire cow who yielded for a time two pounds of butter per day, besides milk and cream used in the house. Amongst the hardiest, most active, and most pugnacious of cows, they will thrive where many other breeds would almost starve, and yet they are found to respond as well as any to generous treatment, though as beef-makers they rank but little higher than the Jerseys."

All that is certainly known about the early history of the Ayrshire, says the Very Rev. Dr. Gillespie, is that it became recognised as a distinct breed in the first half of last century in that county of Scotland from which it takes its name. Its extension, especially in later years, has been more rapid than that of any other kind of cattle in the kingdom. It prevails almost universally in the counties of Ayr, Lanark, Renfrew, and Dumbarton, and it has in a large measure supplanted the native Galloway breed in Dumfriesshire and Galloway. Of late the Ayrshires have been making a steady inroad into England, where they are gradually becoming great favourites. Elegant, symmetrically formed animals, the Ayrshires look well, whether seen in large herds or in small numbers. They are, moreover, remarkably quiet and docile. There is no more peaceful spectacle than that of a large dairy of Ayrshire cows industriously grazing or quietly lying at rest. But they are most highly prized for their milk-yielding capacity, which is really extraordinary considering their size, and the quantity and quality of food they consume. On the other hand, it does not pay to rear pure-bred Ayrshires for grazing purposes. The male calves are fed for veal, with the exception of the few animals, kept as bulls, and the quey calves are reared to keep up the stock of cows, and a few surplus ones for sale. In recent years a large-sized type of Ayrshire has been developed, possessing all the hardiness of constitution and milking properties of the smaller specimens of the breed, and being at the same time large and strong enough to be used for crossing purposes with a Shorthorn bull. Thus, a system of mixed husbandry can be practised, the combining of dairy-farming with the rearing and feeding of half-bred cattle. These large-sized Ayrshire cows are commonly preferred by English purchasers, the cross with the Shorthorn bull being a valuable animal of good size, combining the fattening properties of the sire with the hardy constitution of the dam.

“The form of the Ayrshire,” writes Mr. Housman, “is in strictest agreement with the generally recognised ideal of the true dairy type. It is the wedge, thin-end forward, in a certain sense, but this should not be understood to mean tapering to the front so as to allow no play of vital organs. The fore-legs, on the contrary, are not close together, nor is the chest too narrow, but granted sufficient space for the main-spring and other principal works of the machine, the power acts in the direction of the udder and its tributaries. In the typical dairy cow—let us call her the Ayrshire—we have no ungainly hollows and slacknesses, no rude unevennesses of outline, but head, neck, breast, and



Fig. 19.—Ayrshire Cow, “Bertie 2nd” (3217).

The property of Sir Mark J. Stewart, Bart., M.P.

body all cleanly moulded and neat, the fore-quarters shallow as compared with the perpendicular depth from immediately before the hips, and the top-line straight. The udder has its size in its great length forward under the body and its rise up the twist, and in its true proportion of width to length, and not so much in downward development, which always is, when out of due proportion, an unsightly form never seen in a typical specimen of this breed.”

The high importance of the Ayrshires as a dairy breed is evidenced by the fact that they enjoy almost a monopoly of the great dairy country in the West and South-west of Scotland.

The *Dunlop* cattle are said to have been produced by the introduction of some Dutch or Teeswater cows about the middle of the last century. Their colour varies from a dark brown, approaching that of a Devon, to the cream colour of the Guernsey, and in both cases it is generally

mixed with white. The head, horns and dewlap are small; the neck is thin; the barrel round and straight; the loin and space between the hips are flat and wide; the breed is rather short in the leg than otherwise, and bears a general similarity to that from which they sprang. In some parts they are known under the name of *Cunningham cattle*. There is a district so named in Ayrshire. The Dunlop cheese, once so celebrated, was manufactured from the milk of the Ayrshire cow.

Our notice of the Scotch breeds of cattle cannot be better concluded than by quoting the following observations of Mr. Housman:—

“Scotland is said to have three ‘native’ breeds of cattle—the Highland, the Galloway, and the Aberdeen-Angus—all beef breeds, and one breed, not called ‘native,’ yet regarded as not less Scotch than the ‘native’ breeds themselves, the Ayrshire dairy breed. Local sub-varieties of the three former breeds, and crosses or nondescript mixtures of the various main types, may be found; but under these four heads the recognised breeds of Scotland are classed. To the first, and particularly to the Highland stock of Argyleshire and the Western islands, belongs the reputation of being the representative of the primitive breed of North Britain.

“The origin of the two polled breeds, the Galloway and Aberdeen-Angus, is very obscure. Whether a sport, one sport or more than one sport, from the horned original to the poll, occurred in Scotland, or whether the polled cattle of Scotland were disinherited of the horn through variation which originated elsewhere, we have no record: neither have we any certain evidence of the prior antiquity of the hornless character in the north-east or in the south-west of Scotland. Although a very marked contrast is seen when the Highland and Aberdeen-Angus types are placed side by side, the difference may be graduated by placing between them a specimen of the Galloway type, which has strong points of resemblance to both the other types. The notice of this graduation of typical characteristics by no means forces upon us the conclusion that the Aberdeen-Angus breed is derived from the Highland through the Galloway, but it suggests the possibility that all three breeds are in their Scottish origin akin, and that, with or without the help of alien blood, new types have been evolved on Scottish soil in the course of centuries.

“The Ayrshire type, by its distinctness, tells its own tale of derivation from a different source.”

**THE CHANNEL ISLANDS BREEDS.**—The “Alderney” was the name by which these breeds were formerly known in this country, but the term is now almost obsolete. The native home of the Jersey cattle is the island of that name, and the greatest care is taken to prevent the introduction of other cattle, particularly of Guernseys, amongst the native herds. The home of the Guernseys is in the islands of Guernsey, Alderney, Sark, and Herm, in which the native herds are preserved pure by means of similar precautions.

**THE JERSEYS** (figs. 20, 21, 22) are valued for the richness rather than



Fig. 20.—“Deery,”—“Sweet Secret”—“Rosy.”  
Three Cows of the Blythwood Herd (the Property of Sir James Blyth, Woodhouse, Stansted, Essex), from  
Mr. Edwin Douglas’s Picture, “Prize Jerseys.”

for the quantity of milk which they yield. Being graceful and deer-like in form, they are prized by gentlemen, and gentlemen farmers, in whose grounds they form a very attractive feature. The size of the Jersey breed is small; the colours most esteemed are the light silver-grey, the brown, and the fawn; brindled colours are very rarely met with. The horns are short, and generally curled, and the bones fine. The best milch-cows are observed to have a yellowish circle round the eye, with the skin at the extremity of the tail of a deep yellow colour, approaching to orange. As fattening cattle, they have but few good points; being thin and hollow in the neck, hollow and narrow behind the shoulders, sharp and narrow on the hucks, light in the brisket, and lean on the chine, with short rumps and small thighs; but their flesh is fine grained, high coloured, and of excellent flavour.

The Jersey cows yield the richest of milk; and both on that account, and because of a certain neatness in their appearance, notwithstanding the defects in their shape, they command high prices. They are, therefore, largely in the possession of gentlemen; though now they are being widely disseminated amongst farmers, in some cases with the object of raising the quality of the milk yielded by other breeds, when the milk is all put together. Some of the most characteristic points of Jersey cows and heifers, as recorded in the Jersey Herd-book, are the following:—*Muzzle* dark, and encircled by a light colour (“mealy mouthed”). *Horns* small, crumpled; yellow, and black-tipped. *Ears* small, thin, of a deep yellow colour within. *Chest* broad, deep. *Hide* thin, mellow, and of a yellow colour. *Teats* yellow. *Hair* fine, soft.

In his paper upon “Jersey Cattle and their Management” (Journal of the Royal Agricultural Society, vol. xvii., second series, 1881), Mr. John Thornton says:—“In writing the history of the Jersey cow in this country, it is difficult to distinguish between the Jersey and the Guernsey, and even the Brittany; for all the Channel Islands cattle bore the common name of Alderney, an island that supplies a very small number (scarcely a hundred annually), and whose breed now, by the use of Guernsey bulls, has become larger and coarser than the fine deer-like Jersey. The difference, too, between the Jersey and Guernsey has become very much more marked of late years, both in size and colour, and particularly the head, horns, and nose. The Jersey is the smaller animal, finer in its limbs, neater in its frame, and more thoroughbred-looking in appearance; the horns are thinner and more crumpled, the face finer, slightly concave, and more docile and intelligent in appearance; the eye is bright, black, often with a white rim, and the muzzle intensely black, also with a light-coloured rim round it. This is one of the most striking differences between the Jersey and Guernsey, the latter having usually a flesh-coloured or stained nose, and a lightish yellow and white body, being larger of stature, and coarser of limb. The yield of milk, too, is larger in the Guernsey, yet there is little, if any, difference in the yield of butter; indeed, some contend that the Jersey will yield more butter, and is a smaller

consumer of food. Be this as it may, there is no question as to the Guernsey giving the larger yield of milk; and when large yields are spoken of as coming from an Alderney cow, it is more often to be found from a Guernsey than a Jersey. Guernsey cows have occasionally been taken into Jersey; but crosses between the breeds have not been successful; the yellow colour and pink nose usually crop up in the offspring, which retains a coarseness at once detected and rejected by the Island judges."

Mr. Thornton further says of the Jersey that her gentleness, her small stature, her quietness, her adaptability to any circumstances, as



Fig. 21.—Jersey Bull, "Queen's Messenger" (E. J. H. B. 1206).

Bred by Mr. George Simpson, Wray Park, Reigate.—See "The English Herd Book of Jersey Cattle," vol. ii., 1882.

well as her really large produce when generously fed, all combine to make her a most valuable assistant. As wealth and population increase, large estates around cities are yearly broken up for villas with a few acres of grass and garden. There the Jersey finds a home, and makes a bountiful return for the food supplied her. There she already flourishes: and in time she will doubtless creep into small farms (this she *has* done); for her great dairy profit and her capability of being kept and fed in a confined space are distinct recommendations to the little dairy farmer.

A valuable handbook on "Jersey Cattle: their Feeding and Management" (Vinton) was issued by the English Jersey Cattle Society in 1898:



Saving on two or three exceptional occasions, the Channel Islands cattle had not constituted a feature at any of our great agricultural shows previous to 1871, in which year the Royal Agricultural Society of England, at the Wolverhampton Meeting, effected a final separation between Jerseys and Guernseys. At the great Battersea Meeting in 1862, there was a "large show" of 20 entries, described as "Jerseys, commonly called Alderneys." The Jerseys have now obtained for themselves a permanent place in the Royal Catalogue, whilst the Guernseys only get a section at south country meetings of the Royal Agricultural Society. An admirable display of Jerseys and Guernseys is a characteristic feature of the Royal Counties, Bath and West, and many other shows.



Photo by

G. H. Parsons.

Fig. 22.—Jersey Cow, "Lady Vida."

First at the Royal Agricultural Society's Show at Lincoln, 1907.  
The property of Mr. A. Miller-Hallett, Goddington, Kent.

THE GUERNSEYS are larger, coarser, and less elegant than the Jerseys, and are generally of a yellow-brown colour patched with white, and are sometimes spoken of as "orange and lemon" cattle; but, like the Jerseys, they are excellent milkers, and are now being sought after a good deal. Yet are they not refined and graceful in appearance, or indeed equal to the Jerseys in any respect, save that of size, in which they excel. They are also rather large in the belly; but this, as well as some of the points already mentioned, is rather an advantage to milch-cows; and the udder is well formed (*see* figs. 23 and 24).

The following scale of points, as adopted by the English Guernsey Cattle Society, October, 1886, will serve to indicate the main characteristics of the Guernsey:—

No.	COUNTS.	No.	COUNTS.
1. Head fine and long, muzzle expanded, eyes large, quiet and gentle expression . . . . .	4	10. Hide mellow and flexible to the touch, well and closely covered with fine hair. Yellow inside the ears, at the end of tail, and on skin generally . . . . .	12
2. Horns yellow at base, curved, not coarse . . . . .	3	11. Fore udder large and extending forward and not fleshy, udder full in form and well up behind, with flat sole. Teats rather large, wide apart, and squarely placed . . . . .	25
3. Nose free from black markings . . . . .	1	12. Milk veins prominent, long and tortuous . . . . .	6
4. Throat clean, neck thin and rather long, not heavy at shoulders . . . . .	7	13. Escutcheon wide on thighs, high and broad, with thigh ovals . . . . .	5
5. Back level to setting on of tail, broad and level across loins and hip. Rump long . . . . .	10	14. Size, general appearance, and apparent constitution . . . . .	10
6. Withers thin, thighs long and thin . . . . .	4		
7. Barrel long, well hooped, and deep at flank . . . . .	10		
8. Tail fine, reaching hocks, good switch . . . . .	1		
9. Legs short, arms full, fine below knee and hocks . . . . .	2		

At the Channel Islands Conference of the British Dairy Farmers' Association, May, 1891, a paper on "The Guernsey Cow" was read by Mr. A. T. de Moulpiéd, in the course of which it was stated that the old Guernsey cow was generally a white-faced animal, such as may still occasionally be seen in the island. The strong resemblance of the Guernsey and Norman cattle leads to the belief that both were originally one, and that climate, soil, care, and breeding, have produced the differences which now distinguish them. If, however, the far away past is buried in oblivion and uncertainty, there is at least one landmark which remains, and that is the decisions of the Guernsey Royal Court. It is near a century ago, since the Islands passed laws prohibiting the disembarkation of all foreign animals on their shores. Fines were levied; heavy penalties were enacted against any who should land any foreign animal for breeding purposes; not only the animals, but even the ships that brought them were seized, and imprisonment awaited the crew. A similar law was passed in Jersey. The spirit of the law is the same to-day as it was a century ago, and no foreign animal can be landed except for slaughtering purposes. No French live cattle are allowed to land at all. Spanish live stock are led direct to the slaughter-house, and a record is kept of all English live stock taken inland, which have to be slaughtered within ten weeks of their arrival under a heavy penalty. Records of all animals have to be made at the Harbour Master's Office. Even Guernsey cattle are prohibited from returning to the island, under penalty of fine and slaughter, with the exception of those sent for exhibition at shows, when special declarations have to be made, both for their exportation from and their re-admission to the island, under heavy penalty. Hence it is claimed that the strain of a century ago is the same as that of to-day, the only difference being that the animal is better bred. This enthusiastic admirer of the breed thus proceeds:—

"The Guernsey cow is no mean animal; she weighs from 900 to 1,200 pounds, she is an unpretentious, useful creature, with a form to delight the eye of the practical dairyman, because it means milk. She is of the wedge form, high and broad in the hind quarter, narrowing towards

the front, yet she is not thin in the chest like many milch cows, but has a thickness through the heart which indicates constitution. She has a deep full brisket, a fair fullness in the crop, skin of a rich yellow, and milk and butter more highly coloured than those of the Jersey. In size she is nearly a third larger, and apparently also to about the same extent more robust. An unprejudiced person passing judgment on the two breeds from their appearance only, would say the Jersey belonged to the lawn and gentleman's park, while the Guernsey's place was in the rank and file of the hardworkers, where butter-making meant business. The head, horns, and neck of many are too heavy to look well; the udder and teats are often deficient, particularly the fore



Fig. 23.—Guernsey Bull, "Climax" (E. G. H. B. 14).

Bred by Mr. William Le Ray, Sergentée, Castel, Guernsey.—See "The English Guernsey Cattle Society's Herd Book," vol. i., 1885.

udder and front teats. The udder often appears to be cut away in front, thus giving the teats a backward slant which cannot be called elegant.

"When we come across a Shorthorn or a Hereford, the first impression on our mind is what a fine beef animal; when we see a Jersey, our first thought is what a pretty little beast; but when we meet a Guernsey, the first and lasting impression on our mind is what a splendid milch-cow! You see it in the broad golden rim encircling her eyes, in her clean and glossy horns and hoofs; you see it in the orange-colour of her skin, sometimes so full of yellow dandruff, as to appear as if the animal had been powdered with gold-dust; you see it in a skin as soft as velvet, in her long head and neck, deep wedge-shape shoulders, in her long prominent milk-veins; and, finally, you see it in that large, deep, well-filled silken bag, so yellow, and enveloped by a skin so soft,

so fine, and so thin, as almost to appear transparent; and lastly, if you are incredulous, a look inside the ear will be sufficient to convince you of the excellence of the animal before you. But add to these points—so essential in a dairy cow—her benevolent looking head, with its large dreamy eyes and clear buff nose, and the beautiful coat of red or lemon fawn and white, and you are justified in adding the word beautiful to the quality of good. In appearance she is rich-looking, long-bodied, with a mild and contented expression, always free from nervousness, has a gentle face, quiet temper, and is full of affection. Her head is not delicate, on the average not beautiful, but it is handsome, of good form, long, with a broad muzzle, enabling her to take large mouthfuls.

“The hides of good cows vary considerably in thickness, some are



Photo by

Fig. 24.—Guernsey Cow, “Fi-Fi.”

G. H. Parsons.

First in the oldest class at the Royal Agricultural Society's Show at Lincoln, 1907.  
The property of Mr. E. A. Hambro, Hayes Place, Kent.

thin, fine-coated and soft, others thicker but mellow and unctuous. A moderately thick skin but soft, mellow, loose with elastic touch, are indications of health. Her udder is large, set with good size teats. Both eye and hand find evidence that all the secretions are rich and of high quality, and a careful examination prepares the mind for understanding why the butter from Guernsey milk possesses qualities that are not obtainable from the milk of any other animal. The skin colour is a point in which the Guernsey cow excels all breeds. It is due to a secretion of an oily fat which resembles in colour the butter yielded by the cow. Thus in many common cows, and cows of the beef breeds, high skin colour is rare; among the Ayrshires it is not uncommon; among the Jerseys frequent, and highly prized; while among the Guernseys exceptions are rare. The colour is richer in summer and

paler in winter, this being due to the food. The Guernsey cow has not been spoiled or badly damaged by breeding, according to the whims of fashion, nor has she yet been bred to develop her highest qualities. Her colour varies from orange fawn to pumpkin yellow, broken more or less with white. There is also a very dark solid red, much resembling the Devon. There is likewise the brindle, black and white. Low, in his book on 'Domestic Animals,' published in London in 1841, gives the coloured plate of an Alderney cow with calf at side. The cow is orange fawn and white, with darker shade on the head and neck, and dark nose with a circle of reddish tint around it. The end of the tail is white, the tip of the horns black. The calf is of a lighter orange fawn with greater extent of white; triangular forehead, and buff nose.

"The late Rev. Joshua Watson is the only one who, to our recollection, bred for colour. He went in for the solid lemon fawn, and brought out the noted and famous strain of Cloth of Gold. But the general colour, and that which becomes the Guernsey well, is the light red and white.

"If the Guernsey cow has often been compared to a bag of bones—her abundant yield of rich butter preventing her laying on fat—there comes a time when, in the fattening stall, she will compare favourably with any other beef breed. After milking herself away to a skeleton, and once becoming dry, she will take on flesh like a bullock, losing the thin neck and chin of the deep milker and underlaying her hide everywhere with a fatty deposit. This tendency to lay on fat quickly when dry is possessed by most Guernseys, and is a very important characteristic,—after ten or fifteen years of good work at the pail, after giving twelve or fourteen calves, after yielding on an average a pound of butter a day during that period."

Mr. Housman says of the Jerseys and Guernseys, "The two breeds, although they may have been occasionally crossed with each other, are bred to two very distinct patterns. The red and yellow colours of the Guernsey, usually with white markings and buff noses (although the black nose is sometimes seen), are but little removed in character from the colours of some of the old Teeswater cattle, the stock from which the modern Shorthorn grew; but the Jersey colours have a strong peculiarity not seen in any other cattle of the British Islands. It is in the way in which one colour grows through another, especially in the so-called whole-colours or colours unbroken by white markings; for example, frosted silver on a black, a dun, or a fawn ground. The effect is caused by silver-white hairs, scattered thinly over the body, outgrowing at certain seasons of the year the closer hair of the ground colour. In the hotter months this finer and longer hair is often cast, leaving the ground colour clear or nearly so. Hence, in descriptions in show catalogues or sale catalogues, when any attempt is made to supply more definite particulars of colour than 'whole' or 'broken,' and another season has followed that in which the notes of colour were taken, the animals do not agree with the descriptions given. The same peculiarity may be observed in at least one of the Swiss breeds, which possibly has some remote ancestral connection with the Jersey."

THE TWO BREEDS OF IRISH CATTLE are known as the Kerry and the Dexter respectively, though the latter used to be termed the "Dexter Kerry." Chiefly through the exertions of the late Mr. James Robertson of La Mancha, Malahide, near Dublin, the "Irish beauties" have obtained in recent years a good deal of popularity, and are now to be found in many places in England. Not much bigger than donkeys, they yield a surprising quantity of milk, which is of superior quality. They are mostly kept in the hilly counties of Ireland, and chiefly in the county from which their name is derived.

The first volume of the "Kerry and Dexter Herd Book" was published by the Royal Dublin Society in the autumn of 1890. It is therein stated that Kerry cattle were shown for the first time at cattle shows of the Society at the Spring Show of 1844. A distinct class for Dexters was first introduced in 1876. It is generally believed the Kerry cattle are the descendants of a well-defined native breed of great antiquity; but it is difficult to trace the history of the breed farther back than the middle of the eighteenth century. Since that time the character of the breed in the remoter parts of Kerry seems to have undergone little, if any, change.<sup>1</sup>

The conditions of entry in the Herd Book include (vol. ii.) the following:—

Kerry Bulls must be pure black, with the exception of a few grey hairs about the organs of generation, in animals of exceptional merit.

Kerry Cows and Heifers must be pure black, but in animals of exceptional merit there may be white on the underline, and a few white hairs in the tail—the white on the underline not to extend beyond the forelegs in front, nor in width beyond the line of the elbow.

Dexter Bulls and Cows may be either black or red, with a little white.

Mr. Housman says, in the report previously quoted from:—

"The Dexter—to whatever cross it is indebted for its variation from the old Kerry type—is often also a deep milker, and can breed up to most wonderful proportions of depth and thickness, on its tiny, compact frame. When of a red colour, as it sometimes is, it has been known to present the appearance of a grand Shorthorn seen through the wrong end of a telescope. The blue grey is one of its somewhat attractive varieties of colour.

"The two types are tolerably distinct. The Kerry (figs. 25 and 26)

<sup>1</sup> Mr. (afterwards Sir) William Wilde stated as his opinion, in 1858, that about twenty-five years previously (say, in 1830,) there were four native breeds of cattle in Ireland:—(1) The Old Irish Cow, of small stature, long in the back, with moderate sized, wide-spreading, slightly elevated and projecting horns; in colour they were principally black and red. (2) The Irish Longhorns, resembling the Lancashire and Craven; in some cases the horns were wide-spreading and only slightly curved, but frequently the horns were so completely curved inwards as to cross in front of or behind the mouth: these were large animals of a brindled-red colour. (3) The Maol or Moyle, a polled or hornless variety, similar to the Angus: a medium-sized, docile animal, dun, black, or white in colour, rarely mottled; much used for draught and ploughing. (4) The Kerry, somewhat of a middle horn.—*The Kerry and Dexter Herd Book*, Vol. I.

possesses a light, deer-like head and horn, light limbs, with shoulders, ribs, and hips well set, thin skin, straight back, light well-set tail with long brush, and black as the predominant colour. The Dexter (figs. 27 and 28), as has been intimated, takes very much of the character of a diminutive Shorthorn, with short strong legs, square body, flat back, thick shoulder, short neck, and well-set head and horns."

In former editions of this work it was remarked: "The *Kerry breed* of Irish cattle is the favourite, and is no less remarkable for its diminutive size than for the quantity of milk which it yields. There is little doubt but that the Kerry breed is closely allied to the Bretonne cow, as it closely resembles it in many points. The milk yielded by a

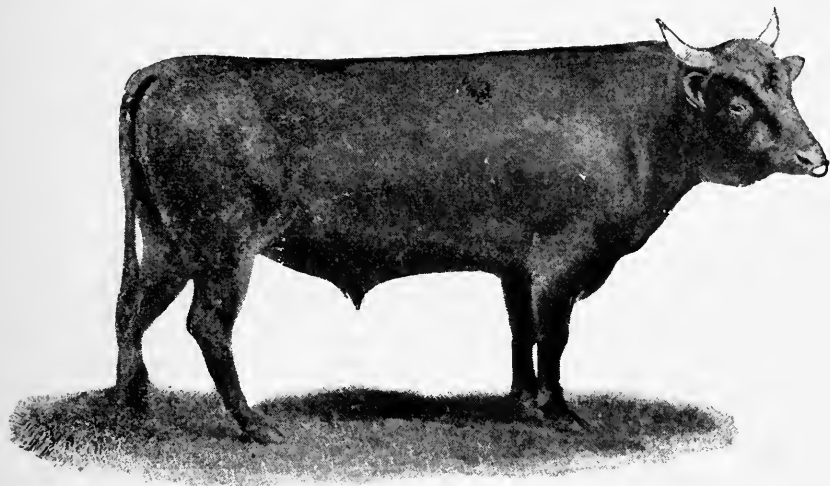


Fig. 25.—Kerry Bull, "Paddy Blake."

Winner of the Gold Medal presented by Her Majesty the Queen, for the best animal in the Kerry classes, at the Jubilee Show of the Royal Agricultural Society of England, Windsor, 1889. Exhibited by the Earl of Clonmell, of Bishop's Court, Straffan, Co. Kildare. Breeder unknown.

pure-bred Kerry is not only large in quantity, but very rich in quality. The Kerry fattens readily, and the meat is of good flavour and of fine grain. The colour varies; in some it is black, in others red and brindled, and in many mottled in these colours; the first named, viz., black, is regarded as the true colour. The hair of the bull, when kept in his native mountains, is long and coarse, but when he is fed in the lowland districts, and on nutritious food, it becomes short and fine. The head 'is small and fine, with a clear bright eye, neck fine, horns short and turned upwards.' Sometimes the horns are not 'cocked' alike, there being a kind of twist in the 'cock,' and some look upon this as one sure mark of a true Kerry. In general they are light in the hind-quarters, but high boned, and wide over the hips."

The counties of Meath, Roscommon, Clare, Limerick, Cork, and Tipperary are chiefly celebrated for the vast herds of Shorthorn cattle, generally, which are there annually bred and slaughtered for exportation; and many of the most public-spirited breeders have, of late years, incurred very considerable expense by purchasing prime stock from England for the purpose of improving their breeds; a measure that has already been attended with the most beneficial effects, and that will, doubtless, in the course of a few years, prove a source of considerable wealth to Ireland. Indeed, the trade in store cattle has largely increased, and is now very important. Norfolk farmers depend largely on Ireland for their supply of stores for yard feeding.

The diversity in appearance in the cattle of Ireland, which is so



Fig. 26.—Kerry Cow, "Flora."

The property of Mr. Martin J. Sutton, Holme Park, Sonning.

obvious to a close and experienced observer, "has arisen," says a writer in the "Irish Farmer's Gazette," "in great measure, from the numerous breeds which have been introduced, especially bulls from time to time, and the careless and irregular manner in which these have been used by the common class of farmers. The imported bulls might be used for a season or two, and the produce would then be put, perhaps to a cross-bred bull, or a bull of no particular breed, simply because such a bull could be got for a shilling, or because the cross-bred bull was most convenient. From this cause, amongst others, there is in many parts of the country a race of mongrels, which it is impossible to assign to any particular breed, whilst in others we may readily detect traces of some distinct breed. . . . So that in some country fairs we have seen descendants of half-a-dozen different breeds, and not a pure-bred animal of any breed on the ground."



Half a century ago (in 1841) David Low, in his work "The Breeds of Domestic Animals of the British Islands," wrote as follows:—

"These cattle are hardy and capable of subsisting on scanty fare. Although stunted in size when brought from the bogs and barren pastures on which they are reared, they make a wonderful advance in size, even though several years old, when supplied with suitable food. The fat of their beef is well mixed with the muscular parts, or, in technical language, marbled; and they fatten well in the inside, a character which renders them valuable to the butcher, and distinguishes them, in a remarkable degree, from the long-horned breeds of the lower country.

"But the peculiar value of the Kerry breed is the adaptation of the females to the purposes of the domestic dairy. In milking properties

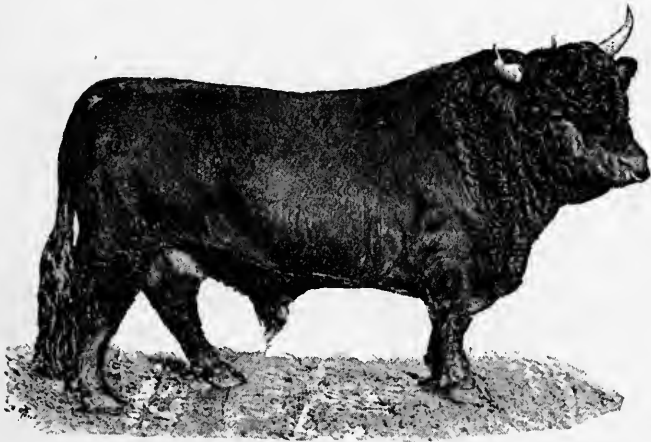


Fig. 27.—Dexter Bull, "Paradox."

The property of Mr. Martin J. Sutton, Holme Park, Sonning.

the Kerry cow, taking size into account, is equal, or superior, to any in the British Islands. It is the large quantity of milk yielded by an animal so small which renders the Kerry cow so generally valued by the cottagers and smaller tenants of Ireland. She is frequently termed the poor man's cow, and she merits this appellation by her capacity of subsisting on such fare as he has the means to supply.

"This fine little breed has been greatly neglected; scarce any means have been used to produce a progressive development of form, by supplying proper nourishment to the breeding parents and the young, and no general care has been bestowed on preserving the purity of the stock. In almost every part of Ireland the breed has been crossed with the Longhorns, and a great proportion of the cows of the country, known under the name of Kerries, are the result of crosses of this kind, and so have deviated in a greater or less degree from the native type, and almost always for the worse.

“A few honourable exceptions, however, exist to this general neglect of the mountain dairy breed of Ireland. One attempt had succeeded to such a degree as to form a new breed, which partially exists with the characters communicated to it. It has been termed the Dexter breed. It was formed by the late Mr. Dexter, agent to Maude Lord Hawarden. This gentlemen is said to have produced his curious breed by selection from the best of the mountain cattle of the district. He communicated to it a remarkable roundness of form and shortness of legs. The steps, however, by which this improvement was effected, have not been sufficiently recorded, and some doubt may exist whether the original was the pure Kerry, or some other breed proper to the central parts of Ireland, now unknown, or whether some foreign blood, as the Dutch, was not mixed with the native race. One character of the



*Photo by*

*G. H. Parsona.*

**Fig. 28.—Dexter Cow, “Compton Daphne.”**

Champion at the Royal Agricultural Society’s Show at Lincoln, 1907.  
The property of the Dowager Duchess of Devonshire, Eastbourne.

Dexter breed is frequently observed in certain cattle of Ireland, namely, short legs, and a small space from the knee and hock to the hoofs. When any individual of a Kerry drove appears remarkably round and short-legged, it is common for the country people to call it a Dexter.

“The Kerry cows afford admirable first crosses with the Shorthorns, Herefords, and other large breeds. Of these crosses that with the Shorthorns is the most general, and appears to be the best. The crosses are found well adapted to fattening as well as to the dairy; and the profit from this system is so immediate that it is to be believed that it will be more largely resorted to than a progressive improvement of the parent stock.

“Nevertheless, the cultivation of the pure dairy breed of the Kerry

mountains ought not to be neglected by individuals or public associations. The breed is yet the best that is reared over a large extent of country, from its adaptation to the existing state of agriculture and to the humid mountains and bogs in which it is naturalized. Were it to be reared with care in a good district, the form would be gradually more developed, and the Kerry breed might then bear the same relation to the mountain breeds of Ireland that the Castle Martin does to those of Wales, or the West Highland to those of the North of Scotland."

At the first Conference of the British Dairy Farmers' Association, held in Dublin, Professor Carroll, of Glasnevin, pointed out that there exists in Ireland a race of cattle eminently suited to dairy purposes. In the county Limerick there may be found cows second to none in respect of yield of milk of good quality. These cows are suited to land of the best quality. Unfortunately, the system of breeding in the district is not calculated to produce animals of uniform excellence, so that it cannot yet be said that Ireland possesses a distinct breed of large cows. In individual cases these cows have yielded 1,000 imperial gallons of milk per annum. The cattle of the extreme south have a large proportion of Ayrshire and Dutch blood. In the beginning of the present century a large number of animals of those breeds were introduced into the south of Ireland. For a considerable time the Longhorn cattle had an important position in Ireland. They were considered to be valuable for dairy purposes. The Holderness breed was imported, but it was found that the Longhorn was a better dairy cow. The Shorthorn breed was introduced at an early period of its existence, and Irish breeders of Shorthorns hold some very valuable animals. The Booth tribe was the variety which gained a footing in Ireland. There can be no room for doubt that the introduction of Shorthorns conferred considerable advantage upon Irish agriculture; they revolutionised Irish cattle, and enabled the country to supply stores as well as to produce some grand fat cattle. It is, however, to be regretted that the Bates variety was not tried in the dairying districts. It will be seen that in Ireland the cattle must be of a heterogeneous character—a mixture of Ayrshire, Longhorn, Holderness, Dutch, and Shorthorn. The ancient varieties of cattle have been to a large extent swept away from the midland and eastern counties, but there is in the south-west a remnant of the old breed.

The Kerry breed, now coming so prominently into notice, is in every sense the dairy cow for poor land. Of hardy constitution, the Kerry will live where other breeds would starve. The cows yield, according to their size and feeding, a larger quantity of rich milk than any other known variety. They are good cattle for grazing purposes, producing beef of excellent quality. The cows will fatten readily if they are not too old. Several attempts to improve the Kerry by crossing have failed to produce an animal superior to the native for its mountain home. What is required is a careful, systematic, and scientific breeding of the Kerry, so as to found a true breed and type. It is satisfactory

to know that the Royal Dublin Society is engaged in this work; and, as is noticed above, has established a Herd-book.

Both Kerries and Dexters have now secured many admirers in England, and are allotted classes at some shows. The English Kerry and Dexter Cattle Society, founded in 1892, published the first volume of the Herd-book in 1900. Crosses between the two breeds not admitted.

We have now given brief sketches of the principal breeds of cattle which are met with on the farms of the United Kingdom. There are, besides, many crosses and local breeds, distinguished by the name of some district, or of the breeder, the description of which would take up more space than their importance seems to demand. Many of these local breeds are, moreover, fast becoming extinct, through the gradual introduction of the more improved breeds of the present day.

Measurements, from the "North British Agriculturist," of the prize cattle exhibited at the Birmingham and London shows, will, in conjunction with the remarks already given, be useful to the reader.

The following are the dimensions of prize cattle exhibited in Bingley Hall, Birmingham, and in the Agricultural Hall, London. The classing of the animals according to age differs—the youngest being placed first in the Smithfield Club catalogue, whilst the oldest are first in the Birmingham catalogue. The ages again are different—the Birmingham classes being for steers under three years and three months, and animals above three years and three months; while the Smithfield Club classes were for animals not exceeding three years and for those above three years. The animals obtaining the third prize at Birmingham were not as a rule measured.

## DEVONS.

	Birmingham.	London.
	ft. in.	ft. in.
Steers not exceeding 3 years—		
1. Girth . . . . .	7 2	7 1
Length . . . . .	4 5	4 8
2. Girth . . . . .	7 4	7 2
Length . . . . .	5 4	4 8
3. Girth . . . . .	0 0	7 3
Length . . . . .	0 0	4 10
Steers exceeding 3 years—		
1. Girth . . . . .	8 4	7 10
Length . . . . .	5 2	4 10
2. Girth . . . . .	8 2	8 3
Length . . . . .	5 0	5 5
3. Girth . . . . .	0 0	7 11
Length . . . . .	0 0	5 2
Heifers not exceeding 3 years—		
1. Girth . . . . .	7 3	7 7
Length . . . . .	5 0	4 8
2. Girth . . . . .	7 7	7 4
Length . . . . .	5 0	4 11
3. Girth . . . . .	0 0	7 6
Length . . . . .	0 0	5 0
Cows—		
1. Girth . . . . .	6 9	7 7
Length . . . . .	5 0	4 9

DEVONS (*continued*).

	Birmingham.	London.
	ft. in.	ft. in.
2. Girth . . . . .	0 0	7 2
Length . . . . .	0 0	4 8
3. Girth . . . . .	0 0	7 9
Length . . . . .	0 0	5 0

## HEREFORDS.

Steers not exceeding 3 years—		
1. Girth . . . . .	7 10	7 10
Length . . . . .	5 0	5 0
2. Girth . . . . .	7 11	7 8
Length . . . . .	5 0	4 10
3. Girth . . . . .	7 10	7 9
Length . . . . .	5 0	5 1
Steers above 3 years—		
1. Girth . . . . .	9 1	8 7
Length . . . . .	5 8	5 3
2. Girth . . . . .	8 7	8 7
Length . . . . .	5 6	5 3
3. Girth . . . . .	0 0	9 1
Length . . . . .	0 0	5 6
Heifers—		
1. Girth . . . . .	8 3	8 2
Length . . . . .	0 0	5 3
2. Girth . . . . .	7 9	8 3
Length . . . . .	0 0	5 0

HEREFORDS (*continued*).

	Birmingham.	London.
	ft. in.	ft. in.
Cows—		
1. Girth . . . . .	8 1	8 2
Length . . . . .	5 0	5 0
2. Girth . . . . .	8 5	8 3
Length . . . . .	5 0	5 1

SHORTHORNS.

Steers not exceeding 2 years and 3 months—		
1. Girth . . . . .	8 2	8 3
Length . . . . .	5 1	4 9
2. Girth . . . . .	8 3	8 1
Length . . . . .	5 0	5 2
3. Girth . . . . .	0 0	7 6
Length . . . . .	0 0	5 2
Steers above 3 years and 3 months—		
1. Girth . . . . .	9 2	8 8
Length . . . . .	5 6	5 4
2. Girth . . . . .	8 8	8 7
Length . . . . .	5 4	5 0
3. Girth . . . . .	0 0	8 10
Length . . . . .	0 0	8 3
Heifers—		
1. Girth . . . . .	8 9	8 8
Length . . . . .	5 4	5 4
2. Girth . . . . .	8 5	8 4
Length . . . . .	5 2	5 2
3. Girth . . . . .	0 0	8 3
Length . . . . .	0 0	5 0
Cows—		
1. Girth . . . . .	8 8	8 6
Length . . . . .	5 2	5 2
2. Girth . . . . .	8 3	8 3
Length . . . . .	5 2	5 2

SUSSEX.

Steers of any age—		
1. Girth . . . . .	0 0	8 3
Length . . . . .	0 0	5 0
2. Girth . . . . .	0 0	8 1
Length . . . . .	0 0	5 6
3. Girth . . . . .	0 0	7 8
Length . . . . .	0 0	4 10
Heifers or Cows—		
1. Girth . . . . .	0 0	8 0
Length . . . . .	0 0	5 1
2. Girth . . . . .	0 0	7 5
Length . . . . .	0 0	4 9
3. Girth . . . . .	0 0	7 9
Length . . . . .	0 0	5 1

NORFOLK OR SUFFOLK POLLED.

Steers of any age—		
1. Girth . . . . .	0 0	8 1
Length . . . . .	0 0	5 2
2. Girth . . . . .	0 0	8 2
Length . . . . .	0 0	5 5

LONGHORNS.

Steers of any age—		
1. Girth . . . . .	8 4	8 0
Length . . . . .	5 5	5 5

LONGHORNS (*continued*).

	Birmingham.	London.
	ft. in.	ft. in.
Heifers or Cows—		
1. Girth . . . . .	7 10	7 10
Length . . . . .	5 2	4 10

SCOTCH HORNED.

Steers of any age—		
1. Girth . . . . .	0 0	7 11
Length . . . . .	0 0	4 11
2. Girth . . . . .	0 0	7 8
Length . . . . .	0 0	4 10

SCOTCH POLLED.

Steers of any age—		
1. Girth . . . . .	9 3	9 2
Length . . . . .	5 8	5 5
2. Girth . . . . .	8 9	9 1
Length . . . . .	5 8	5 8
Heifers—		
1. Girth . . . . .	8 0	0 0
Length . . . . .	5 2	0 0
2. Girth . . . . .	8 0	0 0
Length . . . . .	5 0	0 0
Cows—		
1. Girth . . . . .	8 1	8 3
Length . . . . .	5 5	5 0
2. Girth . . . . .	8 0	7 5
Length . . . . .	5 2	4 10

IRISH.

Heifers or Cows—		
1. Girth . . . . .	0 0	6 6
Length . . . . .	0 0	4 4

WELSH.

Steers of any age—		
1. Girth . . . . .	8 6	8 8
Length . . . . .	5 1	5 10
2. Girth . . . . .	0 0	8 4
Length . . . . .	0 0	5 2
Heifers or Cows—		
1. Girth . . . . .	0 0	6 10
Length . . . . .	0 0	5 2

CROSS OR MIXED BREEDS.

Steers not exceeding 3 years—		
1. Girth . . . . .	0 0	8 0
Length . . . . .	0 0	4 8
2. Girth . . . . .	0 0	7 9
Length . . . . .	0 0	4 11
3. Girth . . . . .	0 0	7 10
Length . . . . .	0 0	8 3
Steers above 3 years—		
1. Girth . . . . .	9 9	8 9
Length . . . . .	5 8	5 2
2. Girth . . . . .	8 2	9 8
Length . . . . .	5 0	5 7
3. Girth . . . . .	0 0	8 4
Length . . . . .	0 0	5 3
Heifers not exceeding 4 years—		
1. Girth . . . . .	8 4	8 0
Length . . . . .	5 0	5 3
2. Girth . . . . .	8 0	8 4
Length . . . . .	5 0	5 0

FOREIGN BREEDS.—We have already described the Guernsey and Jersey breeds, which are universally claimed as those of the Channel Islands. They are more celebrated and useful as milkers than as fattening stock. The Jerseys may be said to be the amateur's or gentleman's stock, as from their comparatively small size, their graceful form and gentle habits, they are better fitted for the small lawn-like pastures of those classes than are our larger and more ponderous breeds of native cattle. Considerable numbers are exported from the Island of Jersey for this purpose.

But the amateurs' breed, *par excellence*, is the "Brittany" or Morbihan breed. There was once quite a mania in this country for animals of this breed, and large numbers were brought over which fetched high prices. This has greatly, if not wholly died away, although numbers are yet to be seen. The great charm which the animals of this breed possessed for amateurs, who had but very limited expanse of grass for feeding purposes, was in their exceedingly small size, their docile habits, and the small extent of pasture which sufficed for their feeding. Not only small in size, they are graceful in their movements, and thus add to, rather than detract from, the attractions of lawns, for feeding on which they are well adapted. Another characteristic, which rendered this breed peculiarly welcome to gentlemen or amateur farmers, was their undoubtedly high milking qualities. Some, indeed, yielded extraordinarily large quantities, taking into consideration the small bulk of the animals, and the little food they consume. The milk is, moreover, rich in quality, and yields a high proportion of butter. The breed is not now—as already hinted—so "fashionable" as it was some years ago, for after any undue excitement there is always a reaction; but it possesses beyond any doubt qualities which befit it for the increased and increasing class who "love to farm a bit." It has been suggested to try the effect of crossing it with some of our own small breeds, as the Kerry cow, for instance, which is notoriously a good milker; or with those of the Channel Islands. The colour of the Brittany cow is generally black and white; its height only from thirty-two to forty-two inches. The form is symmetrical, head fine, short, with well-defined outlines, small muzzle, ears small and well set on, with fine small horns, well set on the head, curving outwards and upwards, the points approaching each other. The neck is fine and slender, the brisket small and not generally prominent. As in all well-bred animals, the back is level, but well set in; the withers are well formed, and loins broad and long. The fore-quarters are roomy, affording ample space for development of the lungs; the legs are short but muscular, and remarkably fine, giving a generally graceful appearance. The hide is fine, giving a good touch; the udder (in the cow) is large. One good point in the breed is their hardy constitution; they can bear exposure to extremes of temperature, and can feed and thrive well, and yield good supplies of milk, on scanty pastures on which others would do but very poorly, even allowing for the difference in size. Although we have given a generally favourable description of the Brittany cow, still it need scarcely be said that there are specimens which do not come up to this standard.

Large numbers of cattle were formerly imported annually from Holland, and from the rich pasture fields stretching along the sand-dune-protected margin of the North Sea from that country almost up to Calais. The Dutch cows are celebrated for their milking capabilities; but the milk, though abundant, is poor, and often contains less than 3 per cent. of fat. They are generally black and white in colour,—often black, with a white “blanket” round the barrel. They are closely allied to, if not the same breed as, the Normandy. While the cows yield large supplies of milk, the cattle fatten rapidly and attain a moderate weight. They are at maturity when about four years old.

Extending our observations so as to take in the regions farther north, we come to that part of what is now Prussia, but which, formerly belonging to Denmark, was so well known as the Duchy of Schleswig-Holstein. Of this the low-lying but splendidly rich and fertile tracts of land which border the seas, the Baltic on the northern, the North Sea on the southern side, are, so to say, crowded with vast herds of cattle of various breeds, some of which are distinct, others more or less allied to one another. Looking down from the elevated roads which run along the tops of the embankments which keep out the sea—in some districts the only point which rises above the universal level—it is difficult to conceive how the land can support such numbers. The secret of this is of course the amazing richness of the soil, which raises crops of the finest grass.

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## CHAPTER II.

### COMPARATIVE VIEW OF THE DIFFERENT BREEDS OF CATTLE.

FROM the foregoing introductory view of the various races of neat cattle, the reader will probably be enabled to form some estimate of the value of the respective breeds therein described. The three which are chiefly reared are the *short-horn*, the *long-horn*, and the *middle-horn* breeds, and concerning their merits and demerits there has always been a difference of opinion among the most experienced breeders. There are also the *hornless* breeds, which of late years have successfully worked their way into the regard of practical men in various countries. These polled cattle are not by any means found in the British Islands only, for there are breeds of them in Eastern Europe; and Professor Sheldon was much interested to find near the City of Mexico, in the spring of 1890, large herds of polled cattle, which were kept for the milk supply of the city, were evidently good milkers, and had various colours of skin.

In fig. 29 we give part of a head showing the first of the above classes, the short-horned; in fig. 30 of the long-horned; and in fig. 31 the full head of the middle-horned.

It has been observed by Mr. Culley, that "the Longhorns excel in the thickness and firm texture of the hides, in the length and closeness of the hair, in the beef being finer-grained and more mixed and marbled than that of the Shorthorns, in weighing more in proportion to their size, and in giving richer milk; but they are inferior to the Shorthorns, in giving a less quantity of milk, in affording less tallow when killed, in being slower feeders, of a coarser make, and more *leathery* or *bullish* in the under side of the neck. The Longhorns excel in the hide, hair, and quality of the beef; the Shorthorns in the quantity of beef, tallow, and milk. Each breed has long had, and probably will have, its zealous advocates; and both



Fig. 29.—Shorthorn.



Fig. 30.—Longhorn.



Fig. 31.—Middle-horn.

kinds may have their particular advantages in different situations. Why may not the thick firm hides, and long close-set hair of the one kind, be a protection and security against those impetuous winds and heavy rains to which the western coast of this island is so subject, whilst the more regular seasons and mild climate upon the eastern coast are most suitable to the constitution of the Shorthorn?"<sup>1</sup>

It should, however, be understood, that the preference above given by Mr. Culley to the Longhorn variety, on account of the superior quality of the beef, applies only to the type of that breed which was selected, improved, and recommended by Mr. Bakewell, and which is described in the introductory account, already referred to, under the name of the *Dishley breed*. In fact Mr. Culley was of opinion that "a breed of Shorthorn cattle might be selected, *equal* if not *superior* to that very *kindly fleshed* sort of Mr. Bakewell, provided any able breeder, or body of breeders, would pay as much attention to these as Mr. Bakewell and his neighbours have done to the Longhorns."<sup>2</sup>

This, as the view of an eminent breeder, was entitled to considerable attention; and was corroborated by a fact stated in the

<sup>1</sup> "Culley on Live Stock," p. 80.

<sup>2</sup> *Ibid.* p. 81.



“Agricultural Survey of Northumberland,” “that the Longhorns had been introduced into that county from the improved stocks of the Midland counties, at different times and by different breeders, but had, in most instances, given way to the improved breed of Shorthorns, and, at the time the first report was published in 1804, had been abandoned by every breeder in the county, the improved breed of Shorthorns, from the stock of the Messrs. Colling, having proved themselves so much superior.”<sup>1</sup>

Since that period, continued exertion has been made to effect the improvement of the Shorthorn breed, and the great weight which these cattle attain must always insure them a high rank in the estimation of those graziers who possess land of sufficient richness to fatten heavy beasts. The popularity of the Longhorns soon passed away. Their *maker*, if he may be so termed—the man who had brought them to the state of perfection which they attained—had scarcely departed ere the character of the breed began to change. “It had acquired a delicacy of constitution,” says the author of the work on “Cattle” in the “Farmer’s Series,” “inconsistent with common management and keep, and it began slowly, but undeniably, to deteriorate. In addition to this, a rival, a more powerful rival, appeared in the field. The improved Shorthorns began to occupy the banks of the Tees. They presented equal aptitude to fatten, with greater bulk and earlier maturity.”

The contest among the larger breeds of cattle now lies between the *middle-horns* and the *shorthorns*, and particularly between the Herefords belonging to the first division, and the *improved* Shorthorns or Shorthorn cattle, belonging to the second. For aptitude to fatten they are nearly on a level, but the Shorthorn may have some advantage in *early* maturity, and will grow to a larger size. The Hereford is not far beaten in either particular, whilst its flesh is of finer grain and flavour. For the dairy, the Shorthorn is decidedly superior. The relative situation, the nature of the soil, and the fancy of the individual, must decide between the two, when the principal objects of the farmer are grazing and fattening. If for abundance of milk, the decision must be given in favour of the Shorthorn.

One other difference there may be between the Herefords and the Shorthorns. The former are more profitable for grazing, and the latter for stall-feeding. The Shorthorns, when in the stall, increase the more rapidly in weight, and present at last a fair and even carcass; they are apt, however, to be patchy, and, generally speaking, there is not the difference in the gross price between the Hereford and Shorthorn which the difference in weight would lead us to expect.

For the northern districts of the kingdom, the Black Polled breeds of cattle are particularly valuable. The breeding of Aberdeen-Angus cattle, for example, has for the last half-century been a labour of love and a work of profit to numbers of skilled farmers. For their tendency to come early to maturity, to fatten quickly,

<sup>1</sup> Page 140, 3rd edition, 1813; in which the assertion remains uncontradicted.

and above all to produce a quality of meat second to none, the Black Polled cattle are remarkable. We have only to note what such breeders as Mr. Hugh Watson of Keillor, Forfarshire, and Mr. McCombie of Tillyfour, Aberdeenshire, did to be convinced of the value of this breed. Quite one-half of the fat cattle once sent from the North of Scotland were crosses between Polls and Shorthorns; but it is denied that the pure breed of Aberdeen-Angus cattle has been crossed.

In instituting comparisons between various breeds of cattle, it should, however, not be overlooked that circumstances of climate, locality, and soil exercise an influence more or less marked upon their peculiarities, and upon their aptitude for fattening and yielding milk, or the reverse. The influence of the parents is also to be taken into account, and the way in which these have been reared and fed, the age at which they are used, and the state or condition of their health. The breeder, if he is to be successful, must indeed be perpetually on the lookout for any circumstances—and, since these operate in a variety of ways, they form a number, so to say, of directions—which are at all likely to exercise an influence, good or bad, as the case may be, on the qualities and peculiarities of his stock. Take, for example, dairy cows. The same breeders set up one class of animal as the best, to the exclusion of all others, without taking into consideration circumstances which naturally affect their milk-producing powers, just as if breed were everything, and food or housing were of no account. The two should, if possible, be made to work together. Breed is good, for it enables the dairyman to get meat out of his food; and it should be remembered, that both the quality and the quantity of the milk, and consequently, to a large extent, of the butter and the cheese made from it, depend more largely upon the breed than upon the food. Take, for example, the breed in Jerseys, Guernseys, Ayrshires, Kerries: in them its salient tendency is milk,—even on poor food in the case of the two last-named; no system of feeding, however good it may be, can cause an inferior cow to yield milk as these breeds do.

As regards different breeds for the dairy, Dr. Voelcker has some remarks which are likely to be useful in choosing the herd. Breeds which have small cows—as, for example, the Kerry or the Brittany, or small animals coming from larger breeds—are, as a rule, those which give the richest milk for the same kind and quantity of food. The Jersey gives the richest milk of any of the breeds, though the Kerry is often equal to it. The Ayrshire breed is celebrated for the excellence of its milk. The Shorthorn is usually looked upon more as a fattening breed than as one yielding a good dairy cow; but certain “families” of the breed give dairy cows which cannot be surpassed as milkers, and yet are almost equally famous for their aptitude to lay on fat, and to improve in condition. The Yorkshire cow is a favourite in many districts, and is the cow *par excellence* of the London dairies; it is closely allied to, and indeed is “eventually a Shorthorn.” It is more useful, however, for the quantity than for the quality of the milk which it yields, quantity

with a population like London obviously being the more valuable peculiarity. And of this breed, it is curious to note—for no reason can be given for the prejudice—that a red cow is the peculiar aversion of the London dairyman, a dappled animal being the favourite. As we have already said, one prefers one breed, another another; one dairyman says that he finds the Hereford breed gives him the finest cows—a breed almost universally thought of only as a fattening breed; another prefers the Devon, while a third deems a cross between them the best. With opinions so diverse, the tyro who is beginning the practice of grazing will own that he has much to do in the exercise of a careful observation, a wise prudence in selection, and a sound and thorough method of treatment and management, before he can lay claim to be considered a “complete grazier.”

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### CHAPTER III.

#### GENERAL OBSERVATIONS ON BUYING CATTLE AND STOCKING A FARM.

THE profit to be derived from the occupation of land depends so much on the command of the requisite capital, that the most important consideration for a young beginner is to be well advised on this essential point, and to be assured that he possesses sufficient means to turn every acre to the best account: always bearing in mind that a comparatively small farm, with sufficient capital, will be more beneficial than another of larger extent without capital to turn the land to full advantage. Assuming it therefore as certain, that the young grazier is provided with this indispensable requisite, we shall proceed to give a few general hints on buying his cattle and stocking his farm; and introduce, under the respective accounts of rearing and breeding the different varieties of stock, such remarks on their merits and faults as will, it is hoped, materially assist him in the course of his labours.

The first object demanding attention is the relation between his stock and the quantity of food that will be necessary to support it. The nature, situation, and fertility of the soils that compose his farm are equally worthy of notice, as well as the purpose for which he designs more particularly to rear or feed his cattle; and chiefly, whether for the dairy, or with the view of supplying the markets. It will be expedient to observe great care in these relations, because, in case he should overstock his land, he will be compelled to re-sell before the cattle are in a fit state for the market, and consequently, at certain

loss; while, on the other hand, he will incur a diminution in his profit, if he should not stock his land with as many cattle as it will successfully carry.

He should next endeavour to procure thoroughly good bulls, for breeding purposes, an extra £10 or £20 being sometimes well expended thus; and he should decide on the breed or breeds he intends to keep, for by purchasing and rearing from different breeds indiscriminately, he will never have a good animal, and eventually his herd will degenerate into mongrels. Neither must he pursue the system of *breeding in and in* too far, or he will find his stock deteriorate rapidly.

Among the various professional breeders of modern times, none have attained greater celebrity than Mr. Robert Bakewell, of Dishley (he died in 1795), to whom we are indebted for many important improvements in the art of breeding cattle. It is difficult to say what were the precise principles that guided him in the selection of his stock, but they were comprised in the four following particulars: beauty of form, or a pleasing proportion between the various parts of the animal; utility of form, or a disposition to accumulate flesh and fat on the best and most useful parts; a fine quality of the flesh; and a propensity to fatten at an early age and in a short space of time. He paid much attention to what is generally termed the *kindliness* of the skin, or a mellowness and softness, and yet firmness, equally distinct from the hard dry integument peculiar to some cattle, and the loose and flabby touch of others.

The practice of judging the animal by the eye only was abandoned, and the sense of touch brought to aid that of sight. By repeated practice, the art of judging of the *kindliness*, or disposition to fatten, arrived at such perfection, that any well-informed breeder, with moderate personal experience, could, on examining a lean beast, tell, almost on the instant, in what points or parts he would or would not fatten.

Sir John Sinclair has given an excellent account of this handling of both fat and lean beasts:—"When the hide or skin feels soft and silky, it strongly indicates a tendency in the animal to take on meat; and it is evident that a fine and soft skin must be more elastic, and more easily stretched out to receive any extraordinary quantity of flesh, than a thick or tough one. At the same time, thick hides are of great importance in various manufactures. Indeed, they are necessary in cold countries, where cattle are much exposed to the inclemency of the seasons; and, in the best breeds of Highland cattle, the skin is thick in proportion to their size, without being so tough as to be prejudicial to their capacity of fattening."<sup>1</sup>

The principles of Bakewell, as above indicated, deserve very attentive consideration.

I. *Beauty or symmetry of shape*—in which the form is so compact, that every part of the animal bears a pleasing proportion to the rest.

<sup>1</sup> "Hints regarding Cattle," p. 157, &c.

This, however, is so intimately connected with the second principle, that we comprise them both in the same description.

II. *Utility of form.*—Both beauty and utility demand that the head of the cow and the ox should be fine and small, gradually tapering towards the muzzle. This is a great point of beauty, and it is also essentially connected with utility, for there are few good milkers, or good feeders, who have not this fineness of muzzle. A thick clumsy head denotes a want of refinement and of quality. The neck, towards the setting on of the head, should be finely shaped, although it may be allowed somewhat rapidly to thicken towards the shoulder and breast. The chest is an all-important part. It should be deep and broad, and carried forward to the fullest extent. The back should be broad as well as level, and the barrel ribbed almost to the hip. There should not only be room for the heart and lungs before, but for the capacious paunch behind. The loins should be wide at the hips, but not too prominent, for there is the most valuable meat. The thighs should be full and long and near together, and the legs short almost to a blemish. The bones of the legs should be small, but not disproportionately so, and the hide mellow, and fairly loose—everywhere covered with hair, soft and fine, but not effeminately so—feeling like a soft rug doubled in the hand. Such is the animal in which the qualities of beauty and utility are blended.

III. The *flesh*, or texture of the muscular parts, is a quality that necessarily varies according to the age and size of cattle, yet it may be greatly regulated by attention to the food employed for fattening them. It is best shown in the flesh being marbled, or having the fat and lean finely veined or intermixed, when the animals are killed; and, while alive, a firm and mellow feeling.

IV. In *rearing live stock* of any description, it should be an invariable rule to breed from fine-boned, straight-backed, healthy, clean, kindly-skinned, and barrel-shaped animals, having clean necks and throats, and little or no dewlap; carefully rejecting all those which have coarse legs and roach backs, or with much appearance of offal. As some breeds have a tendency to develop great quantities of fat on certain parts of the frame, while in others it is more mixed with the flesh of every portion of the animal, this circumstance will claim the attention of the breeder as he advances in the knowledge of his business.

V. In the *purchasing of cattle*, whether in a lean or fat state, the farmer should on no account procure them out of richer or better grounds than those into which he intends to turn them. He should select them either from stock feeding in the neighbourhood, or from such breeds as are best adapted to the nature and situation of the soil. As an example, it may be noticed that Highland cattle will often thrive on English pastures that are unsuited to most delicate animals.

VI. *Docility of disposition* is an object of great moment; for, independently of the damage committed by cattle of wild tempers on fences, fields, &c., it is an indisputable fact that *tame beasts require less food*

to rear, support, and fatten them. Every attention should therefore be early paid to accustom them to be docile and familiar; and gentle, kindly, equable treatment will most effectually conduce to this end.<sup>1</sup>

VII. *Hardiness of constitution*, particularly in bleak and exposed districts, is a most important requisite. It usually depends on *form*; all animals with fine arched ribs, and wide chests and backs, are more likely to prove hardy than those having their fore quarters narrow.

There is a rather prevalent opinion that white is a mark of delicacy of constitution; but the wild cattle of Chillingham are invariably of that colour, and the highest-bred Herefords are distinguished by white faces.

VIII. Connected with hardiness of constitution is *early maturity*, which, however, can only be attained by feeding cattle in such a manner as to keep them constantly in a growing state. Beasts and sheep with this propensity, and thus managed, thrive more in one year than they would do in two if they had not sufficient food during the winter.

IX. There is in some animals a *kindly disposition* to accumulate fat on the most valuable parts of the carcass at an early age, and with little food, compared with the quality and quantity consumed by others. On this account smaller cattle have been recommended as generally having a stronger disposition to fatten, and as requiring, proportionately to the larger animal, less food to make them fat; consequently, a greater quantity of meat can be produced per acre. "In stall feeding,"—the nature, method, and advantages of which will be stated in a subsequent chapter,—it has been remarked, that, "whatever may be the food, the smaller animal pays most for that food. In dry lands, the smaller animal is always sufficiently heavy for treading, in wet lands he is less injurious."<sup>2</sup> This opinion, however, is combated by some very able judges, who still contend that the largest animals are the most profitable. They doubtless may be so on strong land; but the smaller animals will thrive on soils where heavy beasts would decline.

X. Besides the rules thus stated, there are some particulars with regard to the *age* of neat cattle and sheep, which merit the farmer's consideration.

"Neat cattle cast no teeth until turned two years old, when they get two new teeth. At three they get two more; and, in every succeeding

<sup>1</sup> Mr. Edwin Ellis, of Shalford, Guildford, a very successful breeder, says (Journal of the Royal Agricultural Society, 1890):—"I have always tried to make every man who looks after my stock, of whatever character, an enthusiast in his work. When that is accomplished, your feeding will be satisfactory, and not till then. No feeding can answer if you have a stupid clown throwing in just as much food to one animal as to another, putting fresh victuals on stale ones, and frightening the animal every time he approaches it. I have had such men, and soon parted with them; but when you have inoculated your man with your own enthusiasm, you have got at the root of all good feeding. Watchfulness of appetite, of likes and dislikes, humouring the dainty, changing the unappreciated food, and withholding food when the animal appears surfeited—these are methods that bring success. The man has got to love and understand his animal, and you then do far better to trust him as to feeding than to lay down a diet scale to be strictly adhered to."

<sup>2</sup> "Journal of the Bath and West of England Society," vol. x. p. 262.

year, two, until five years old, when they are called *full-mouthed*; although they are not properly full-mouthed until six years old, because the two corner teeth, which are last in renewal, are not perfectly up until they are six."<sup>1</sup>

The horns of neat cattle also supply another criterion by which the judgment may be assisted, after the signs afforded by the teeth become uncertain. When two years old their horns are without wrinkle at the base, but at three years old a circle or wrinkle appears, to which another is added at every year, so that by adding two to the number of these circles or rings, the age of an animal may be ascertained with tolerable precision, unless these rings are defaced or artificially removed, by scraping or filing—a fraudulent practice that has been adopted in order to deceive the ignorant or inexperienced purchaser. These circles, however, must not be confounded with other small rings that are sometimes found at the root of the horn, and which are a tolerably sure indication that the animal has been ill fed during its growth; another frequent consequence of which is that the horns are crooked and unsightly. There is often a tip at the extremity of the horn, which falls off about the third year.

The bull is termed a *bull calf* until he is one year old, and then a *yearling bull*, and afterwards a two, three, four, and five-years-old bull, until six, when he is *aged*. When castrated, he is called a *steer calf*, then a *yearling steer*, then a two or three-years-old steer,<sup>2</sup> and so on until after four, when he becomes an *ox* or *bullock*.

The cow does not assume this name until four years old; up to one year old she is called a *heifer-calf*; from one to two years a *stirk*; from two to three, a *twinter* (i.e., two winters); and from three to four a *heifer*. There exists, however, much difference of opinion as to the exact application of the term heifer.

XI. As supplementary to the matters already discussed in this chapter, bearing on the characteristic "points" which distinguish good stock, and as taking up also one or two subjects which should be considered by the grazier in stocking his farm, we give the following paragraphs.

In a small but valuable pamphlet, by Mr. E. F. Wilkes, there are some excellent and practical remarks and illustrations, constituting "a guide to form in cattle." The pamphlet was published at Hereford by Mr. Head, and the hints given are so good, that we do the reader a service by drawing attention to one or two of the leading points to be observed in "form" in cattle, illustrating these by sketches adopted from the drawings given by Mr. Wilkes. "Form," or the external outline of what may be called the framework of the

<sup>1</sup> "Culley on Live Stock," pp. 208, 209.

<sup>2</sup> The word "stot" is very generally used in Scotland in place of *steer*. In Robert Burns's well known poem, "The Calf," we read:—

And if the lovers' raptur'd hour  
Should ever be your lot,  
Forbid it every heavenly power  
You then should be a stot.

animal is, Mr. Wilkes remarks, of the utmost importance; for however much an animal may be covered with fat, unless the form permitting this be good in its points, the animal is defective, and that in proportion to the defects in the form. Mere size or bulk does not constitute perfection in cattle, although this is a point of great importance, and upon it will be found a few remarks in this chapter at another place. But size, combined with good points of form, goes far to make good cattle, to which, if there be added a ready tendency to take on fat and flesh evenly, and a fecundity which ensures the animals breeding freely, then, what may be called the "standard of perfection" may fairly be looked upon as having been reached.

Breeders know well the value of ample width, giving space in the fore-quarters of the animal for the important organs of respiration. The form of the bosom and shape of the brisket is one indication of good form at this point, and it influences also the tendency to lay on fat evenly. In fig. 32, the diagram marked *A* at top shows a good form; in this bosom the front view is rather level from *a* to *b*, the centre *c* being kept up, not pendent or projecting; while, at the sides joining



Fig. 32.—Good (*A*) and Bad (*B*) Forms of Bosoms.

the arms inside, the spaces are well filled up with muscles. The opposite of this—which, however, is sometimes much admired—is roughly indicated, in a purposely exaggerated form, in the diagram *B* in the same fig. 32. The centre *a* of the bosom is deep and pendent, and the insides of the arm at *b* and *c* are not well filled in with muscles. Of the two forms here sketched, Mr. Wilkes states that that in *A*, fig. 32, "affords in reality more width in the carcass generally, and is adapted in well-bred animals to carry the most meat in a given compass.

While discussing this important part of the frame or form of cattle, designed for meat producing purposes, it will be useful to indicate two forms of the bosom or brisket, as in fig. 33. In one diagram, marked *A*, the best form is shown; this gives a "full round bosom," carrying its width through the lower part of the chest, with sufficient circularity in the under part of the pectoral ribs. The diagram marked *B* shows a bosom terminating deeply and abruptly behind the fore legs as at *a*; in place of being kept almost level as in the corresponding point in the diagram marked *A* in the same figure. Viewed in profile, the form of brisket or lower part of the bosom is very different in the two; in diagram *A* the shape is full, well rounded, with an easy curve; in



diagram *B* it is pointed, and has a sharp curve going up to a point behind the fore-legs. Other delineations of "briskets" are shown at *b* in figs. 38, 39, 40, and 41.

Although it is a point not much thought of by some breeders, or, if so, not deemed important as influencing the qualities of the animal, yet the way in which the shoulder-blade is "set on" does influence the pectoral or chest region, which we have shown to be of high

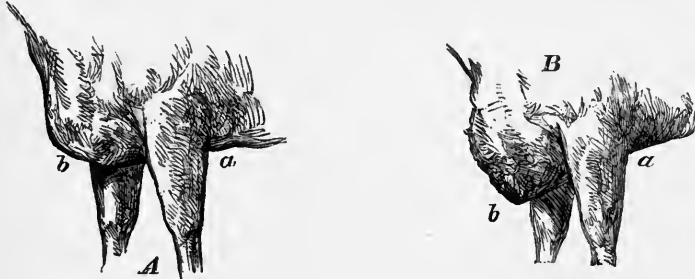


Fig. 33.—Good (*A*) and Bad (*B*) Forms of Briskets.

importance. Thus the falling down behind the shoulder-blade, as in fig. 34 at *a*, is a defect "which is commonly accompanied with a want of sufficient capacity in the chest." But, in the illustration in fig. 35, this part, as at *a*, is well filled up, giving, as Mr. Wilkes remarks, a good chine. This form, he says, is a most difficult thing to acquire in an animal, so as at the same time to get length and depth of frame. The best form of chine is one which is thick and round,



Fig. 34.—Drooping Shoulder-Blade.

rather than one elevated much above the shoulder-blade. The position of the shoulder itself should not be overlooked. When well placed it should fall somewhat back in an easy gentle curve; it should not stand almost vertically up, or give what is called "an upright shoulder," as this is generally accompanied with coarseness of bone. See also figs. 38, 39, 40, and 41, at *c*.

The "setting on" of the tail is another "point" which should not

be overlooked. Fig. 36, diagram *a*, shows a tail "set on" too high, giving a falling in behind and on the rump; in diagram *b* the tail is "set on" too low, giving an ugly rise in the rump, with depression behind towards the tail. Fig. 37 shows a tail better "set on," nearly on a level with the general line of back, and giving a better shaped rump at *a*,— the illustration, however, might be



Fig. 35.—Full Shoulder-Blade, giving good Chine.

improved. This last figure (37) also illustrates an important point to aim at—namely, a full thigh and a low and deep flank. A thin thigh and high flank should be avoided. The high flank shortens the ribs, which some breeders do not like, as it gives too deep a belly; but by care this may be avoided, and a fair length of

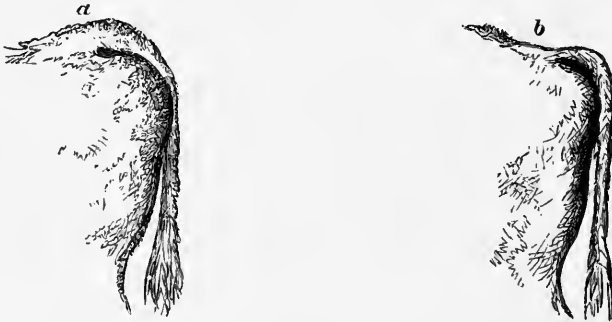


Fig. 36.—(a) Tail "Set On" too High. (b) Tail "Set On" too Low.

rib obtained, so as to give the desirable depth of flank and roundness and thickness of thigh. A well rounded ear, standing clear out from the head, is a better indication of a tendency to take on fat quickly than a drooping, slouching, and narrow ear.

While on the subject of form or contour we may direct the reader's

attention to one or two remarks contained in a paper read before a conference of Shorthorn breeders in America, by Dr. Sprague, of Iowa, who, it is evident, is thoroughly acquainted with his subject. He dwells upon the importance of attending to the conformation and consequent contour of that part of the frame of the animal which contains or covers those vital organs—the heart, the lungs, and the liver. As closely connected with this part, he says that two of the worst defects in the contour of a Shorthorn, and, indeed, of all other stock, are the following:—First that form in which the ribs start from the spine, and go downward in such a direction that they give a wedge-like shape to the upper third part of the chest; the second is a long rib, which, deficient at its lower end, causes an upward curve to be formed in the lower line, at a point immediately behind the fore-legs. The defects are so bad that he doubts if there are any others which are so difficult to “breed out.” A rump, he



Fig. 37.—Tail “Set On” better than in Fig. 36.

says, which droops, or a forward carriage which is low, may be made to disappear in the course of two or three “crosses,” and so that they may not reappear in future progeny; but the two defects above-named, depending upon deficient vital organs within, are not so easily dealt with and got rid of. It may take many crosses of the most judicious kind to plant large vital organs in the offspring where they have been deficient, even although this latter may have been the case in one parent only.

Notwithstanding that the statement is somewhat paradoxical, it is nevertheless true that the “short ribs” (or false ribs,—see page 398) should be long; and in place of bending sharply down, as they do in badly-formed beasts, they should stand out from the spine horizontally, so as to form a level place in front of the hips. This is a good “point,” and should be cultivated by the breeder, as it generally accompanies, and thus perhaps influences, the round deep chest which is, as we have shown already, of such import-

ance. Every inch of additional width obtained by this point in the "rear third" of a fattening ox, gives a "cut" one inch in thickness, and in surface extending from top to bottom,—something worth trying to get for the butcher and the cook.

When a hind-quarter "holds its width well back" in the beast, it carries a larger weight of meat than the hind-quarter which "narrows in quickly" back from the hip. In conclusion, let the breeder bear in mind that a perfect contour in a fattening beast gives such an evenness to the flesh in all parts of the body,—so well distributed, to use another phrase,—that it is difficult to tell where one "point" ends and the next begins.

Although not connected with contour, but closely related to the subject of good flesh,—which it is the object of contour to lay evenly upon the frame of the fattening beast,—is that of the "texture" of the flesh, the importance of which it is impossible to over-estimate, notwithstanding that it is a detail generally over-looked by breeders, and often by butchers. The feel or touch is supposed popularly to indicate the texture of the meat, but Dr. Sprague very properly points out that it is not a correct, often indeed a very misleading, guide. Texture can only be judged correctly by the eye; and, as said above, it is not all breeders, even good ones, who can tell what it is. Good meat should not have its fibres so distinctly visible that they may be seen like layers of veneer or thick cardboard laid side by side; but they should so run into and blend with one another that it is not easy to say where one ends and the other begins. Colour, too, we may also here remark, is a good test of meat. Blue-toned and dull-looking meat is not good, neither is dark sombre-tinted. It should be clear, ruddy, and fresh-looking.

As regards general contour of cattle, an animal is supposed to be well fattened and filled up—to have, in fact, good form—if, when looked at sideways, it has a rectangular shape. This is popularly called "square," but of course is not truly so. The dotted lines in figs. 38, 39, 40, and 41, indicate what is meant; the rectangle in these is made up of two rectangles of equal length, owing to the top and bottom lines being taken along the back and belly lines of the animal, and in a direction parallel to the ground line, *g l*.

The diagrams not only illustrate our remarks as to "points," &c., but enable comparative observations to be made of different animals, showing how the position, form, &c. of the "points" vary in these animals. The figures 1, 2, 3, 4, 5, 6 and 7 of the rectangle give distance-points from which the position of the various "points," and their forms, may be ascertained. For example, the point 4 (see figs. 38 to 41) gives the distance-point for measuring the position of "brisket" *b*. (See fig. 42 for positions and designations of "points" of cattle; also fig. 43 or index of points in a typical specimen of the Aberdeen-Angus breed). The point 2 gives the means of measuring or noting the fall or depression of the back *a*, and the distance *a a* shows the depth of "barrel;" the figure 5 the rise 5 to *d* of the "plates;" the figure 6 the distance of the thigh or hough *e*; the figure 1 the position of the "pin

bone" or "tail-head," and so on; the points in all the diagrams, figs. 38, 39, 40, and 41, being the same. The height of legs from the ground line, *g l*, (or line 7, 8, 9,) can be measured or estimated by distance from

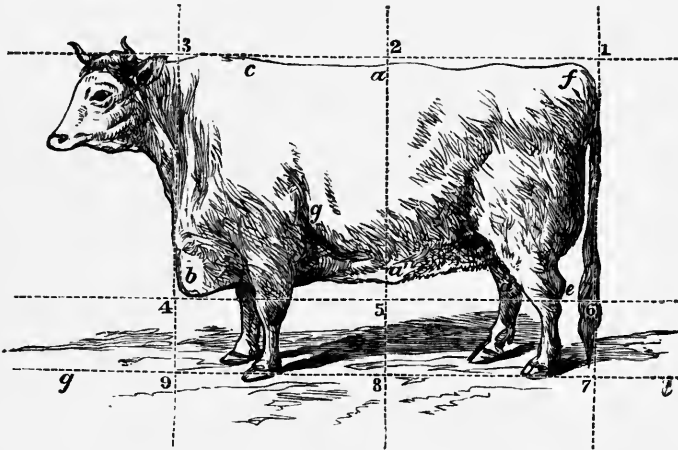


Fig. 38.—Contour of Ox.

the line 4, 5, 6. In all the figures above named, *d* indicates the "flank," *c* the rise of shoulder as explained in connexion with figs. 34 and 35.

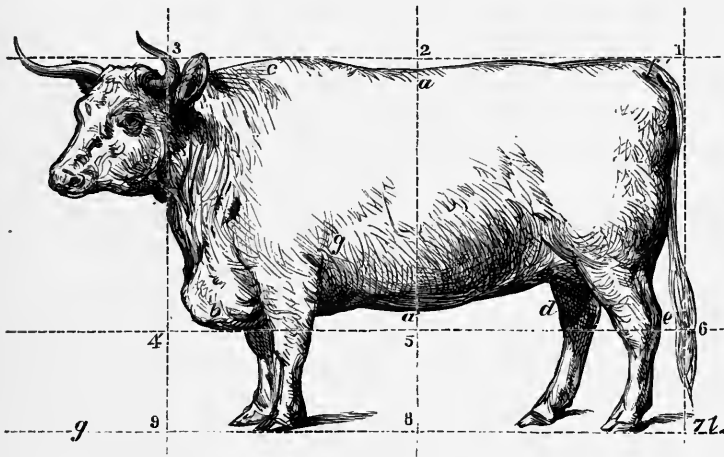


Fig. 39.—Contour of Heifer.

XII. *On the Judging of the Value of Stock by the System of Points.*—At one, and that no very distant, period in the history of agriculture, it was held by many of its most advanced practitioners that it was discreditable that no standard or standards could be set up, by which to

estimate and value the various breeds of cattle and their several examples or specimens; that all was left to chance, or rather to the experience gained by long and intimate dealings with the animals; and

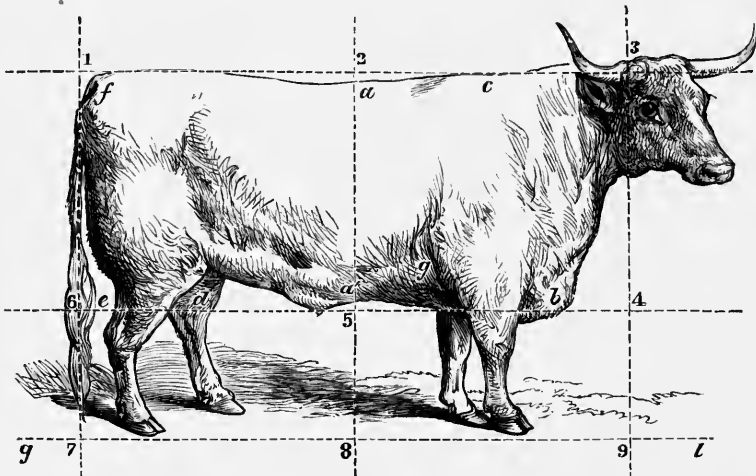


Fig. 40.—Contour of Ox.

that nothing was left but this by which to determine their worth. At length the system of "points" was advocated, and by many practised,

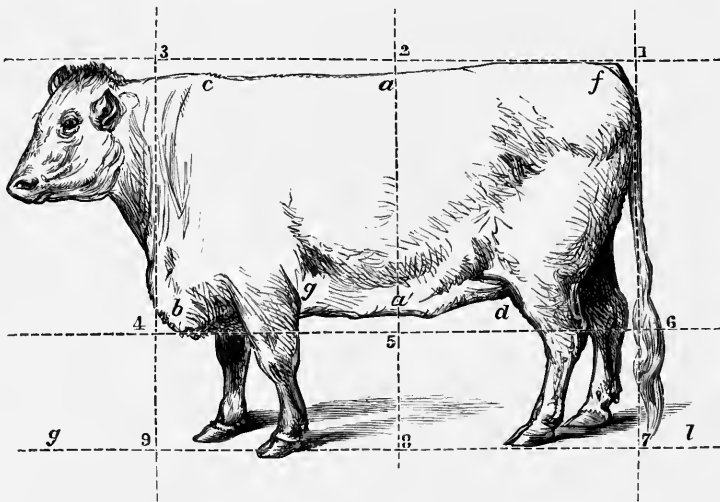


Fig. 41.—Contour of Polled Ox.

although no official recognition of it was made for some time. We have given a sketch of the principal points which are generally understood to be indications of the value of cattle; but there are

obviously other “points,” if so they may be termed, which are of great importance in estimating the value of an animal, but which cannot be so marked or “ticketed,” so to say, as to be visible to the eye, and reckoned up like the items of an account; such are the quality of the animal, its

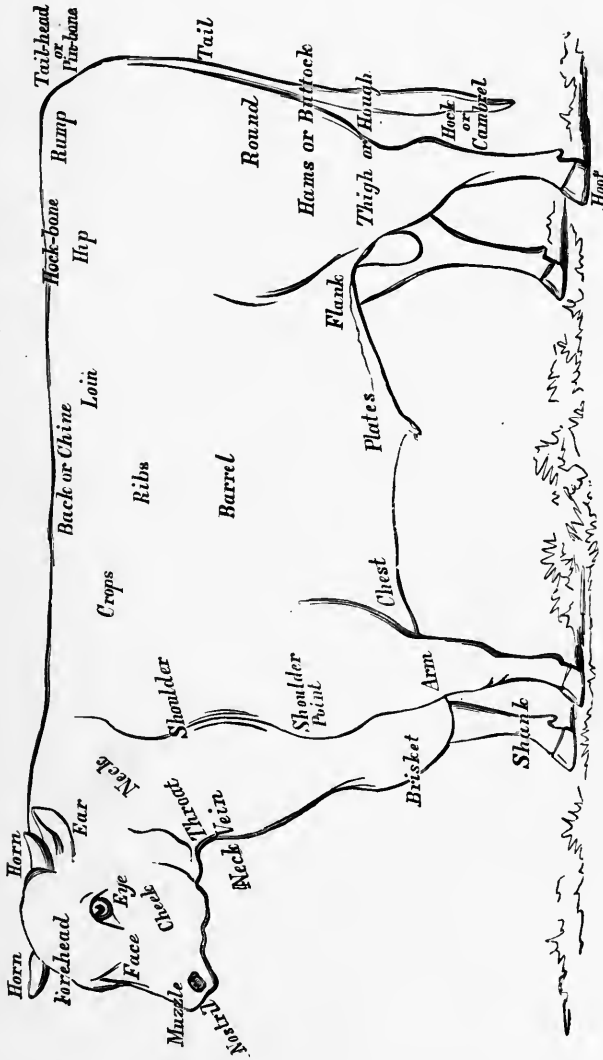


Fig. 42.—Diagram Illustrating Positions and Names of “Points” in Cattle.

vigour as a breeder, &c., &c. Even the “touch,” to which so much importance is attached and which in some scales of points has a certain value set against it, is one which, being a variable quality, will have, as in practice it has, a variable value. On matters such as these each individual who is examining an animal has his own opinion.

Hence, it remains true in practice, that these opinions—"awards" as they are technically termed under the auspices of an agricultural society—are not generally received as being true expressions of the value of the animal or animals under inspection, or "judging;" but, being looked upon more as expressions of individual opinion, are valued and set down accordingly. It is not therefore to be wondered at, that these opinions, or "awards," give rise to much discussion and sometimes to dissatisfaction. Hence it is that attempts have been made to institute

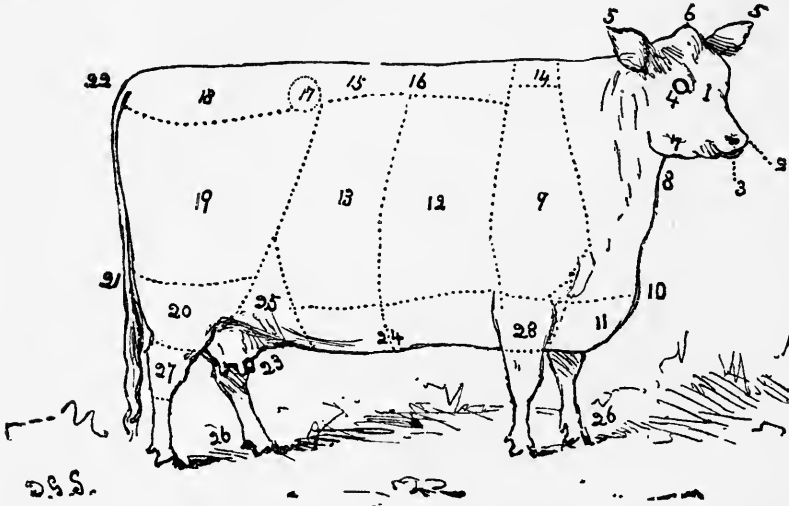


Fig. 43.—Index of Points in a Typical Ideal Specimen of Aberdeen-Angus.  
(FROM THE POLLED HERD BOOK, 1889.)

- |                       |                         |                           |
|-----------------------|-------------------------|---------------------------|
| 1. Forehead and Face. | 11. Bosom (or Brisket). | 20. Thigh.                |
| 2. Muzzle.            | 12. Fore Ribs.          | 21. Twist.                |
| 3. Nostril.           | 13. Back Ribs.          | 22. Tail, and Setting on. |
| 4. Eye.               | 14. Crops.              | 23. Udder.                |
| 5. Ears.              | 15. Loins.              | 24. Underline.            |
| 6. Poll.              | 16. Back.               | 25. Flank.                |
| 7. Jaws.              | 17. Hooks.              | 26. Legs and Bone.        |
| 8. Throat.            | 18. Rump.               | 27. Hoek.                 |
| 9. Shoulders.         | 19. Hindquarters.       | 28. Forearm.              |
| 10. Chest.            |                         |                           |

some other method of arriving at an opinion as to the value of cattle, especially where they are exhibited at shows, and are therefore as a consequence looked up to, or likely to be looked up to, as "models."

The subject is of great practical importance, and should be so discussed and decided that a system which can be relied upon for accuracy may be established. Such discussion has to a certain extent been forthcoming; and, amongst the papers which it has produced, perhaps one of the most valuable is that published by Mr. Alexander Bruce, Chief Inspector of Live Stock for New South Wales, and which first appeared in this country in the pages of "The Farmer."



Mr. Bruce, in introducing the system which he advocates, and which we shall presently allude to, draws pointed attention to the defects of the present method. We have already adverted to the fact that animals vary in the points of excellence or defect which they possess. Thus, as Mr. Bruce remarks, one animal may be valuable or high in "quality," but it may be defective in "form;" or while good in some points of form which indicate value, it may be as noteworthy for having other points of form which indicate the reverse; or it may be good both in form and in quality, and yet defective in vigour and size. Now, judges "being," as one of them once remarked, "but men," have like other men their prejudices, fancies, or predilections, one arguing for one point, another for another. Hence, in judging, more especially where the animals are numerous, the practice virtually is a species of summing up, or counterbalancing of the one point of an animal against another, in order to arrive at a conclusion, which, being a species of "average decision," will be as fair as it can possibly be made to the exhibitor of the animal in question. If one judge alone was employed at shows, even this system would be unsatisfactory; but where there are, as is usual, two or three, it is worse. The result often is that the best talker gains the day, or the most determined in standing out, or else lots must be cast as to which of the three decisions is the one to be made public.

Another defect of the system is the hurry of the examination. On this point we have only to ask anyone to compare the difference between the style of a man who is examining an animal in order to purchase it for himself with that gone through at a show, to convince him that, where so little time is given to a work which all admit to be one requiring great deliberation and care, such work cannot be done well. We have alluded to the prejudices of judges—indeed, of all who are concerned with stock—as to certain "points" as placed against other points in an animal; but there is one prejudice well known to exist amongst these judges, and that is in favour of one or another class or strain or "breed" of animal. With some, if the animal is not of *their* breed, no matter how good it is, it stands a poor chance of gaining a favourable decision. All who know anything of stock, know what is meant by a "Booth man," or a "Bates man," and of the strength of the prejudices which these terms convey.<sup>1</sup>

But we come to a far more important defect of the present system, as pointed out by Mr. Bruce; important, inasmuch as it affects the whole question of the improvement of the breeds of cattle throughout the country. The difficulties attendant upon the gaining of a knowledge of stock are known, but not so well known, perhaps, as they should be. Such being the case, it would be satisfactory to know the opinions of the judges, setting forth authoritatively the points in which the prize-winning animals excelled: the "reasons why," in short, the awards were made as they were. By this means an "authoritative record of those points would be created;" and, further, breeders would be directed, "who are looking for stock to improve their herds in

<sup>1</sup> See "Thomas Bates and the Kirklevington Shorthorns." By Cadwallader John Bates. Newcastle-upon-Tyne: Robert Redpath. 1897.

particular points, where animals high in those points are to be found," and the "questions as to what breed of stock is the most profitable for the breeder and the farmer would be in a fair way of being settled." Mr. Bruce advocates a very complete register of points being kept by the judges, and the publication of these would make each exhibition or show "thoroughly educational," whilst they would afford the largest amount of practical information with respect to stock, and their excellences and defects, thereby teaching the uninitiated, and educating the rising race of breeders.

We confess to having a difficulty in seeing why the same thing should not be done in the way of the live-stock department by the leading shows as is done, for example, by the Royal Agricultural Society of England in the department of steam engines, in which a vast amount of detailed information of a highly practical character is given upon the "points" or "marks" of all those tried,—not merely the prize engines. If this were done as regards stock, breeders would be as well informed in their department as machinists are in theirs. And yet there must be some difficulty in the way, for it is not done. However, as on almost every other subject, so on this, "many men have many minds," for we find a "breeder" in a leading journal almost scorning the idea of having any "system of points" to indicate the value of cattle, and who maintains that while fancy animals, pigeons, terriers, &c., may be judged by "points," it is wholly out of place in "adjudicating on the merits of Shorthorns, Herefords, or Devons, whose beauty, utility, and fashion are so intimately blended." In animals of the higher class, he says, "we have a combination of the useful and the ideal which can only be properly recognised by a critical taste as well as judgment, not in its ultimate analysis above law, but certainly not subservient to figures." But surely, if the system of points be not subservient to figures—which, by the way, are but the conventional organs used in order to give in the briefest fashion the relative values of certain points—the judges would be able to publish the reasons for their awards. These reasons *they must have had, or ought to have had*, before the awards were given; the one being the foundation or basis of the other, without which it could not exist. If this, and this only, were done, one of the advantages we have already pointed out, by a system of judging other than that now in use, would be gained by the public. That there are certain indications of value in a breed cannot be disputed; and if a well-defined system could be agreed upon by which these points could be valued, or made clear to the public, we see no reason why it should not be adopted.

In laying down a scale of "points" generally applicable, it would be desirable that there should be a general system of technical names of the parts of animals; that is, there should be a universal nomenclature. For one on hearing the breeders or sellers of different districts talk about the peculiar merits of their animals, or a student in agriculture in reading what may be written thereon by different authorities, would be quite at a loss to know, in several instances, what were the parts meant. The technical names used in the North of England and

in Scotland are different in some instances from those used in the South, although the parts are the same in both. In one sense this is of no great importance, as "dealers" will soon find out, and do soon find out, these differences. But its importance becomes evident as soon as the subject of a universal code of "points" is broached,—a code of practical value for purposes of reference. For it is at once obvious, even to the least practised mind, that the reference cannot be universally made unless the corresponding points have identical names which are to be universally recognised.

In the judging of cattle, or in deciding their value, it is surprising what a diversity of opinion exists, even amongst those who are considered first-rate practical men, as to the method which should be adopted. Some decide on the value of a fat beast entirely by the eye; others, again, almost wholly set aside the system of points, and trust to their handling—or "touch," as it is also called—of the various parts; while others combine the two, looking at the points and also handling the beast. But little as some regard the value of the "touch" or the handling, there can be no doubt that it is of great importance in helping one to decide as to the value of a fat beast. A soft, movable, or what might be called almost a species of floating feel of the skin at certain parts, as at the ribs, is a good sign of the quality of the meat. But this—and here the value of the system of judging by combining points and touch is shown—should be in conjunction with well rounded ribs, for flat ribs will generally give a hard unkindly touch. With ribs well rounded, and the skin of the soft movable kind above noticed, the hair or "coat," as in some districts it is generally termed, is thickly laid on, and in place of being hard, short, and wiry, is soft, and feels something like the nap of fine silk velvet. All these taken together are indications of a good fattening beast, which is likely to prove, as the saying is, one which will "put its meat into a good skin"—a saying, by the way, which, old as it is, shows that from early times the skin was looked to as a "point" in a good beast. They also show that it is not easy to judge a beast by one method alone. It may be so in the case of fattening beasts, but certainly the touch or handling cannot be dispensed with in the case of dairy cows. In the chapter treating of these we allude to the "milk veins;" now, although these can be seen and their value so far decided on, they must be handled and felt before this can be fully the case. Even in a fattening beast the touch of the "neck vein" is of importance, for by it one can tell the condition of the fat at once about the shoulder point. Generally, the touch or handling, as in the cases cited, is done with the finger-points; but a good judge, by passing the hand flat over certain parts, as along the back, can tell at once the parts which are in good flesh and fat condition, and those which are not so.

We have said that, as regards form, a rectangular outline, seen to be well filled up when viewed sideways, is a good indication of a well-conditioned beast. The same standard is also valuable when applied to the back as looked down upon, or what an architect would call a "ground plan," the side frame corresponding to a "side elevation." The back,

broad and level, of a well-formed good-conditioned animal, will fill up this frame, as in fig. 43, the hinder quarter, from the hock bones to the rump or pinhead or tail-bone, forming a kind of rounded triangle, the front quarter a kind of square rounded off at the shoulder points. What might be called a "back elevation" would show a *square* frame equally well filled in from the hock bones to the thighs, both of these parts being rounded off to meet the back at the rump and the thighs at the lower part. The "front elevation," so to say—keeping up the similitude borrowed from architectural nomenclature—would also show a "square frame," the shoulder-points at the front showing a breadth nearly the same as that of the hock bones at the hind-quarters.

Such, then, may be taken as some of the leading features of the methods in use for judging the value of fattening beasts; but, from what has been said, it will have been, we trust, perceived by the tyro in the art of grazing, that to make a good judge he must take every opportunity of examining and handling the animals themselves; attending sales and shows, visiting "crack farms," and educating himself by all the means at his command; using his ears in listening to what known judges, experienced feeders and breeders, and successful dealers say of certain animals, his memory in remembering all that is said, his eye in noticing the difference between good and bad form, and his delicacy of touch in handling the beasts that come under his notice. It takes the exercise, indeed, of no small amount of skill in observing, noting, remembering, all the points to be considered in cattle-judging, and the novice may conceive that he has no mean task before him when he bears in mind the saying of one of the most successful breeders of the century—that not a day passed over his head when he was amongst stock but what he saw in them something he had never seen before, and learned some new point of which before he had been ignorant.

XIII. *On the Selection and Management of Store Cattle in Stocking the Farm.*—No class of farm stock in the department of cattle require in their selection the exercise of so much skill and judgment, and in their management so much care, as store cattle.<sup>1</sup> Many think that any sort of beast will do to lay in, feed up, and sell off at a profit. But a little consideration will show that store cattle are the source from which are drawn the supplies of animals which are sent to market, and how to forward them there in the best condition, with the least expenditure of food and labour, is the problem which the store cattle-keeper has to solve. An eminent feeder states that it is one of the most difficult problems in stock-keeping to know how to decide upon the value and qualities of store cattle.

The sooner store cattle can be got out to grass in spring the better; and if attention has been paid to the pastures so that there is an early bite of fine, sweet, rich grass, it is surprising how rapidly the animals improve. If well kept during the winter, and put out to grass as now stated, they will add as much as one-fifth, or at least one-sixth, to their live weight during the first four or five weeks of early

<sup>1</sup> The term "store" is applied to animals not yet put upon fattening food.

and good grass feed. Of course, much will depend not only on the grass but on the weather. And, as regards the grass, it is, as we have elsewhere pointed out, an important matter to keep changing the pastures. This plan, if judiciously conducted, on a farm on which there is a wide range of different fields, will alone greatly increase the pasturing value of the fields. The changes should be made about every fortnight, or every ten days, according to circumstances. Much greater attention requires to be given to pasture fields than is generally the case. If the weather is continuously wet, or if much rain falls during a given time, so as to render the surface "trashy," it is quite a mistake to put cattle upon it, however fine the grass may be, and tempting therefore to the grazier for his winter-fed "stores." They will not only be themselves injured by exposure to the wet, at this early season too generally accompanied by cold winds; but they will, being in a restless uncomfortable state, keep wandering up and down till the field is "poached" and tracked up; it will thus be spoiled, not merely for that season, but very likely for several seasons. In this department, therefore, as indeed in all others connected with stock, the master's eye has constantly to be on the look-out to observe what has to be done, what ought to be avoided. This, indeed, is but one of many illustrations of the saying, "The master's eye feedeth the ox."

In pasturing grazing cattle, much depends necessarily upon the kind of pastures fed off. There is a great difference between the systems of pasturing fields of new and of old grass. In new grass land, for example, there is a certain period in early summer when the grass makes a sudden advance; and if not eaten down at the proper time it will soon become coarse and rank, so that in the course of a little longer time it will hardly be any better than dry half-withered "fog," with little or no nutritive properties. Hence the field will prove little other than a dead loss to the grazier. Close attention should therefore be paid to this condition of the grass, so that it be eaten off when at its best; then the cattle should be taken off and the land allowed to rest; in time the grass will be as sweet and good as ever, and then the cattle may be put on again. It is attention, never flagging, never wearying, to such points as these that causes the difference between the grazing which pays and that which does not. And, unless the grazier is determined to give this close attention, he had far better never undertake the calling. Losses in grazing are often attributed to bad cattle, bad land, bad seasons, to anything and everything bad, in fact, but the bad management, which alone, is really the cause of many of the losses which are so bitterly deplored, and of which we hear so much.

We now come to the wintering of the store cattle, after the pastures have passed their best, and the beasts have to be put upon turnips. A high authority states that the sooner the cattle are put up the better,—much, however, must depend on the weather, and in certain circumstances cattle will do as well on the pastures as in the yards up to the end of September. He sows every year from twelve to sixteen acres of tares (vetches) and at about the beginning of July

sets aside a portion of the new grass full of red clover, and from the 1st to the 17th of August the tares and the clover are fit for the cattle. The cattle begin to enter the yards about the first of August, those required for the Christmas markets being drafted off, thus giving relief to the pastures and yet leaving enough cattle in them. Through the months of August, September, and October, the cattle do best in the yards, but, when the weather becomes cold, stall-feeding is preferable. The cattle should not have unripe tares given to them; they should be three parts ripe at least; and, when mixed with the red clover, a capital feeding mixture is produced. To follow the tares, yellow turnips should be ready. About ten days after the first lot of stock has been taken up from grass, a second lot is taken up, thus further relieving the pastures, and allowing the cattle left in to thrive all the better. The whole of the cattle are thus gradually drafted from the fields to the fold, regularly in succession till the end of September, at which time all ought to be under cover which are intended to be fattened during the winter; care being taken, as above noted, to draft off the strongest and best first—those meant for the Christmas sales—till the worst only are left, and these also eventually come into the fold.

The late Mr. Wm. M'Combie, of Tillyfour, one of the most skilful of feeders, has left on record some excellent advice, a part of which has already served as a text for the immediately preceding pages:—

“If a grazier has a number of fields and many cattle, to carry out the treatment of his cattle properly, shifting to fresh grass once in ten or fourteen days should, if possible, be adopted. The grazier must always consider the quality of his grass land, and buy cattle adapted for it. It would be very bad policy to buy fine cattle for poor or middling lands. You must always keep in view how the cattle have been kept. If they have been improperly kept for your purpose, their size, whether large or small, will not save you from loss. If the cattle are kept on cake, corn, potatoes, or brewers' wash or grain during the previous winter, it will be ruin to the graziers. You must not think that I wish you to buy lean, half-starved beasts. What I wish you to understand is, that you must keep the cattle always full of flesh; and, as a breeder, you must be careful *not to lose the calf flesh*. If you do so, by starving the animal at any time of his growth, you lose the cream—the covering of flesh so much prized by all our best retail butchers. Where do all the scraggy, bad-fleshed beasts come from that we see daily in our fat markets; and what is the cause of their scragginess? It is that they have been stinted and starved at some period of their growth. If you once lose the calf flesh, you will never regain it. You may get a great deal of tallow internally by high feeding, but you will never again make the animal one that will be prized by the great retail butcher.”

As to the breeds best adapted for store cattle under this system, which is that adopted in the northern counties, the following is the conclusion come to by our authority—namely, that the best beasts are the Aberdeen-Angus Polls, and the crosses of the Aberdeen with the

Shorthorn. The age of the store cattle is a point which should be considered. It is stated that, although no doubt a two-year old will put on more meat than a three-year old, and for a "long keep will pay as well," yet he prefers matured cattle, as they "get sooner fat, are deep on the fore-rib, and take less cake to finish them off." For the more southern parts of the kingdom there is a wide choice amongst the breeds of the Shorthorns, Herefords, Devons, Sussex, Welsh, and the Red Polled, with their crosses.

Though Mr. M'Combie's views are interesting as showing his own practice, many of his ideas are repudiated now, even in the county where he lived and worked. His opposition to covered yards, for instance, meets with no support in Aberdeenshire, as all the farmers in that county would gladly use covered yards if they could get them, and many of them now have covered yards. In the same way his argument against the buying of store cattle which had got any allowance of cake or corn during the previous winter is abundantly disproved by the everyday practice of thousands of farmers throughout the country. He had a wide connection among the Aberdeenshire farmers through supplying them with Aberdeen-Angus bulls, and he went largely about among them for the double purpose of buying and selling pure-bred stock, and buying up their cross-bred stock for feeding in his own folds or pastures. In that way he knew precisely how the cattle which he bought were reared. But the practice of going about buying up the stock of the breeders is now mainly monopolised by the dealers, so that the farmers have as a rule to go to the auction marts, and must be guided solely by their own judgment and the appearance of the stock.

The management of store cattle, like that of other departments of stock, varies, as we have already remarked, with climate, locality, and soil, and the grazier must keep such point always before him if he would be successful. For observations on the "Principles and Practice of Breeding" the reader is referred to the Book on Horses (Chapter III., page 417).

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## CHAPTER IV.

### OF THE BULL.

THE bull generally attains the age of puberty as early as twelve or fourteen months, and may be used moderately at this age without injury. Young bulls which have been suckled on the cow in a pasture will generally serve cows more readily at an early age than those reared in the house. It is not advisable to put old or heavy bulls on young heifers. Neither is it well to allow the bull to run in the pastures with

cows, and especially is this practice injurious to young bulls, often spoiling their tempers, besides doing them other harm; wherever the situation can by any means be made to admit of its being avoided, this should never be permitted. As it is desirable at times for the bull to have exercise, he should be allowed a loose box when young, and should be regularly rubbed down every day, as that conduces to health, and as he gets older he should be led out occasionally. The temper of the animal much depends upon the treatment he receives, nevertheless some bulls are naturally far more vicious than others.

As much, if not more, attention should be paid to the size and qualities of the family of the male as to those possessed by himself. Many a small bull, if well descended, will produce finer stock than a heavier animal whose pedigree is not so good. Particularly in a dairy herd, there are good grounds for the assertion that the milking propensity is quite as transmissible through the male as through the female line, and in view of the large number of offspring of one bull as compared with those of one cow, it is argued that the milking aptitude is preferably propagated through the male. Bulls of good dairy character are distinguished by the possession of fairly developed teats. A male should not be hastily rejected; some graziers fatten and slaughter a bull after he is two and a half or three years old, and before his capabilities as a stock-getter can possibly have been sufficiently tested. Others, on the contrary, going to the opposite extreme, will rear and breed from bulls got by inferior parents, and which are themselves very mediocre animals.

In dealing with this subject, Mr. Gilbert Murray (*Journal of the Royal Agricultural Society*, vol. i., Third Series, 1890), has the following pertinent observations:—

“Soil and climate to a considerable extent fix the habitat of the different races of our domesticated animals. Whatever the breed, the first stage of improvement must begin with the male, and to this end it is essential that pure-bred sires be used. I have known many instances, in the dairy-districts, of well-bred Shorthorn bulls being used for a few years; then, on the mistaken notion of a narrow-minded economy, a bull-calf is saved from a favourite cow, and eventually used in the herd, which soon reverts to its original state. To a tenant-farmer of ordinary intelligence, I cannot conceive a more interesting and profitable branch of his calling than that of building up a herd of milking-cows, let the breed be what it may. Throughout the dairy districts of the Midlands we pin our faith to what is generally known as the home-bred, or Yorkshire Shorthorn, which for the general purpose of the locality cannot be excelled.

“Commencing with well-selected cows or heifers of unrecorded pedigree, on which is used a pedigree bull, it is surprising what improvement can be made in a few generations. The ordinary dairy-farmer, as a rule, has a horror of pedigree; and yet, at the depleting farm sales, hair, colour, and quality invariably induce competition; this year I have known unpedigreed yearling heifers make up to £16 each. A dairy-farmer should keep a separate milk record of every cow



in his herd ; yet many neglect this important point on the plea of extra trouble. It is not trouble, but method, which results in profit, not only because it enables the owner to draft out inferior milkers, which leave only a small margin of profit beyond the cost of food, but because a good milk record enhances the market-value of the animal."

The late Professor Tanner gave the following as *points of a well-developed bull*.

"The *head* should be rather small in proportion to the animal, and well set on the neck, with a fine tapering muzzle, a broad forehead, bright, full, yet placid eyes, furnished with a graceful horn of fine quality, and ears small and fine.

"The *neck* should be thick, but not too short, having a graceful appearance by tapering steadily towards the head, and yet not getting thin behind the ears.

"The *shoulder* should be snugly set in the carcass ; it should be covered with a well-developed muscle down to the knee, below which it should possess a fine and flat bony structure.

"The *chest* should be bold and prominent, wide and deep, furnished with a deep but not a coarse dewlap.

"The *carcass* should be barrel-shaped, having a top level and broad, especially across the hips ; the ribs should be well rounded ; the space between the last rib and the pin should not be too short ; yet at the same time we must guard against too much length ; there will, however, be little cause for objection, if the rib is well rounded, and the bone flat, for it will add weight to the animal in a good part. The flank should be full and pendent.

"The *hind legs* should be full and fleshy down to the hock, with a well-developed buttock, showing great substance, but below the hock we require a fine and cleanly formed bone.

"The *tail* should be finely formed without much hair.

"The *hide* mellow to the touch, covered with a fine yet plentiful coat of hair."

The following remarks are by the late Mr. Edward Bowly, of Siddington, the well-known Shorthorn breeder :—

"In the selection of a bull, so much depends on the character of the female he is required for that it is almost impossible to lay down a rule on paper. To secure, however, a decidedly masculine character, it is better he should be too coarse than too fine. The man who at present possesses an ordinary herd of cows has a very simple course to pursue. If he will procure a well-descended bull from any improved breed, he will make great advance ; even if the bull is not a first-rate animal himself, the offspring will partake most of the character of the purest and oldest blood, on whichever side it may be. The produce of a pure bull and an ordinary cow will often surpass in many points the high-bred sire ; but it would be wrong to use a cross-bred bull, even if he were very good, for his stock would almost invariably be inferior to himself.

"In proof of the general result of using a pure-bred sire, I knew a man who began breeding with a very inferior herd of cattle, the greater

portion being the black Welsh, and by using pure Shorthorn bulls for three or four generations he produced from them a very respectable herd of Shorthorns, and entirely lost the black colour; yet I doubt not that, if he had ventured to use one of the bulls bred by himself, the black colour of his Welsh ancestors would have appeared again."

A very important point connected with the life of the bull is the age at which he should commence to propagate his kind. This is alluded to at the commencement of this chapter, and the age is named—a year old—at which he may be used moderately for this purpose. It is an invariable practice, not only of ordinary breeders, but even of the best breeders of pedigree stock, to give yearling bulls a fair and reasonable amount of service, and they are found to thrive just as well as though they were kept completely celibate. In the same way breeders of pedigree draught horses will regularly give even their most valuable two year old colts as many as 30 or even 35 mares to serve, and they will grow and thrive just as well with that amount of work as though they were fed "at haick and manger."

The reader may here be referred to an instructive paper, "The Value of Pedigree," by Colonel Sir Nigel Kingscote, K.C.B. (*Journal of the Royal Agricultural Society*, vol. iii., 3rd series, 1892, page 31).

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## CHAPTER V.

### OF THE COW.

COWS are purchased with a view of either being fattened for sale, or for breeding, or for the purposes of the dairy,—the two latter being generally combined. In the first case it will be advisable to attend to the kindliness of their skins, and the disposition to fatten. With those that are intended for breeding, care should be taken to select the best of the particular stock that is to be raised; and, for the dairy, those that yield the most and the richest milk. The desirable qualities of a dairy cow are, that she should give an abundant supply of milk, fatten readily when milking is over, and turn to good account in the shambles. As the dairy constitutes, in many parts of the kingdom, an object of great importance, it is worth much consideration whether a particular breed should be kept for that purpose, or whether it is preferable to have stock partly adapted for the butcher and partly for the dairy. "It is probable," observes Sir John Sinclair, "that, by great attention, a breed may be reared, the males of which might be well calculated for the shambles, and the females, when young, might produce abundant quantities of good milk; and when they reached eight or nine years of age, be easily fattened. This," he justly remarks, "would be the most valuable breed that could be propagated

in any country; and, indeed, some of the best English and Scottish breeds have almost reached that point of perfection." Such an object would be readily attained if it were more the practice to use bulls from the best fattening stock with the best milch cows.

"Some attention has been given to a discovery which was made by M. Guenon respecting the '*escutcheon*,' as it is termed. . . . It can scarcely have escaped the reader's notice that the hair on the buttocks of cattle grows in two different directions, one portion pointing up, and another part downwards, thus producing a sort of fringe at the line of juncture. This hair which has an upward tendency has been termed the '*escutcheon*.' A very extended observation has shown that, '*other conditions being equal*, the modification of form presented by the escutcheon will lead to an estimation not only of the *quantity* of milk which the animal will produce, but also of the *time* during which the cow will *keep up the supply* of milk. Without going much into detail on this point, it may briefly be stated that the larger the extent of the escutcheon the greater is the promise of milk, and also of its continuance, even after the cow is again in calf. A cow may have a small escutcheon and yet be a good milker; but observation leads to the conclusion that if she possessed a more fully developed escutcheon she would have been a better milker. It may be considered a point of merit not as *deciding* whether or not the cow is a good milker, but rather as an additional indication, which may be taken into consideration, in conjunction with other characteristic points. It is also desirable, in estimating the extent of escutcheon, to make full allowance for the folds in the skin; otherwise a large escutcheon may be taken for a small one. Besides the escutcheon, there are tufts of hair (*épis*) which have a certain degree of value when seen upon the udder of a cow.'"<sup>1</sup>

M. Guenon in his system divides cows, according to the quantity of milk which they give, into four classes. (1) First-rate cows (*les très bonnes*); (2) Good cows (*les bonnes*); (3) Middling cows (*les médiocres*); and (4) Bad cows (*les mauvaises*). He, however, before proceeding to describe and illustrate the signs of the four classes, warns his readers that this classification is used only to give a summary of the marks he has been discussing. For there is no mark which can serve for methodically classifying cows as milkers; if the *escutcheon* had any determinate or exact value (*une valeur certaine*), it would still be necessary to take into account the extent of the surface, or the form which the basis constituting the escutcheon cover will assume. This cannot be done easily, nor if done would it be valuable, unless the shape and weight of the cow were also taken into account. The forms or shapes of the escutcheon also are so various, that the classification of cows according to the quantity of milk which they give is adopted by M. Magne.

*First Class. First-rate Cows.* In this class are placed cows in which both the mammary and the perinæal divisions of the escutcheon

<sup>1</sup> "On Breeding and Rearing Cattle," by Professor Tanner, in "Transactions of Highland Society."

are large, continuous, and uniform, and cover at least a large portion of the perinæum, the inside of the thighs and the udder, extending moreover, with little or no break, more or less over the limbs; elliptical in shape and situated in the posterior face of the udder. The escutcheon marks just described, although observed in very good cows, are not always indicative of them, for they are also found in middling or mediocre animals. But the cows may be considered first-rate as milkers, if, in the absence of a well-developed escutcheon, they possess the following marks. Veins of the perinæum, varicose and visible externally, or at least easily made so by compression at the base of the perinæum; veins of the udder large and knotty; milk veins frequently double, and equal on both sides of the animal, and forming zig-zag or wavy lines within the belly. In addition to the marks shown by the veins and by the escutcheon, the udder should be large and yielding, of homogeneous texture, having a thin skin covered with fine hair, and yielding or shrinking much under the process of milking. The chest should be ample, and a good constitution displayed by regular appetite and a disposition to drink much; the skin soft and supple (fine touch), hair short and soft, head small, horns fine and smooth, eye quick but gentle, fine neck, and feminine air.

*Second Class. Good Cows.* These present the mammary portion of the escutcheon well developed; but the perinæal portion is either wanting or but partially developed. The milking qualities of cows should be doubted where large veins do not accompany the escutcheon. This remark is applicable in special degree to those cows which have had many calves, and are in full milk; for, be the escutcheon never so well developed, the cows are middling or bad, and do not belong to either the first or second class, if the veins of the udder are not in considerable numbers, and the milk veins under the belly are not large. The general characteristics, as noted in the first class, are of course not to be neglected.

*Third Class. Mediocre Cows.* Possess the lower tuft of the escutcheon of the mammary part little developed or indented, and the perinæal portion irregular, narrow, and contracted. The udder in cows of this class is small, with hard skin, and will shrink little on being milked. The veins of the perinæum are not visible, and the veins of the belly are small and straight. The head is large, skin stiff and thick (bad touch), and the animal is often peevish and restless.

*Fourth Class. Bad Cows.* Possess escutcheons of very small extent; no veins are visible in the udder or the perinæum, and the milk veins are feebly developed. The cows of this class are generally in good condition, and showy, taking animals. The thighs are fleshy, the skin hard and thick, neck thick, head and horns large, and the latter of large diameter at the base.

Breeders interested in this phase of the subject will find very full information thereon in a *brochure* of 150 pages, published by Messrs. Trübner & Co., under the title "How to Select Cows; or the Guenon System simplified, explained, and practically applied," by Willis P.

Hazard. This is a new edition (1889), revised and enlarged, and there are nearly one hundred illustrations. The reader may also be referred to an illustrated paper, "Guenon's System of Selecting Cows by the Escutcheon," by Mr. Hazard, which was printed in the Journal of the Royal Agricultural Society, vol. xxi., second series (1885). Mr. G. W. Baker contributed some observations on this paper, amongst them the following:—

"The perfection of milking characteristics, to my taste, is an animal with a fine escutcheon, with rather thin thighs, giving plenty of room for the bag to extend itself when necessary; the udder, of course, should be deep and broad, extending well forward, with four well-placed teats of medium size, and with the skin of the udder as elastic as a kid glove. Then with a cow of good constitution, a well-formed body, on four good legs set outside of her, with a rather fine long head set on a thin neck, with silky hair (if it is a little long so much the better in this changeable climate), covering a rich elastic skin, I think you may expect pretty good results in the dairy. The horns should be fine and well placed in the head, curving rather inwards than otherwise, and the back should be straight, with a rather long tail starting from the body at right angles with the back, if you want a handsome animal; and of course it is desirable to obtain as many points as possible. Beauty must be admitted in judging for competitions, although it is not an essential characteristic for the dairy; and consequently a *pretty* animal may sometimes properly be dispensed with when brought into contact with a neighbour who surpasses her in usefulness, although lacking some of her good looks. The cow should be able to move well, and possess an appetite that will enable her to support her constitution when she is making a liberal return to her owner, who is treating her well."

While considering the points by which good dairy cows may be ascertained, attention may be directed to a suggestive paper which was published in the Proceedings of the Board of Agriculture of Ohio, in the United States, and proceeded from the pen of, as its facts and suggestions were based upon elaborate investigations made by, Dr. Sturtevant. The theory upon which this author bases his practice in deciding the value of dairy cows, is capable of very simple statement, namely, that the type of the breed of a cow has a certain determinate relation to the quality of the milk which the cow yields. Naturally, the milk produced by a cow is just that which is required to rear or suckle her calf, and all which she yields in addition to this owes its existence to art; in other words to the peculiarities or habits induced by the way in which cows are domesticated and made subservient to the necessities of man; and it is remarkable how the animals change, not only their external form, but their internal functions, to meet those requirements, when put under certain modifying influences. Thus the Ayrshire, which Dr. Sturtevant calls the "symbolization of the dairy type," has been altered in its development, and can be again altered by certain styles of breeding. But the true typical Ayrshire dairy cow has her teats set wide apart in the udder, and the teats are small and short and cylindrical in form, the udder

being flattened and held close and firmly to the belly by a fibrous tissue, partly elastic. In the Holstein breed and the Dutch, a black-and-white, the cow has a long-shaped udder. In the Jersey cow the glands of the udder are pointed, the teats cone-shaped, and set closely together in the udder. These three breeds Dr. Sturtevant takes as the types of dairy cows, and he finds, on examining the milk of animals of these breeds, that the butter or fat globules vary in each, both in their size and number. The result of a number of experiments is thus summarized:—

(a) The butter globule of the Jersey breed is larger than the corresponding globule of the other breeds mentioned, and there are fewer globules—for convenience called granules—under 1–27,000 of an inch in diameter.

(b) The butter globule of the Ayrshire is smaller than that of the Jersey, and intermediate in size between that of the Jersey and that of the Holstein; and the milk from individual cows of the Ayrshire breed can be grouped in two classes or grades, according to the size and distribution of the globules. This milk abounds in granules.

(c) The butter globule of the Holstein is the smallest of the three. The globules are more uniform in their size than in the Ayrshire milk, and there are fewer granules.

From these Dr. Sturtevant deduces in like manner the following propositions:—

1. The butter globules show a certain and definite relation between the quality of the milk and the breed.
2. The breed determines to a large extent the composition of the butter.
3. The breed determines to a large extent the most economical and advantageous manufacture of cheese.

As there is a “breed” difference in the product from the udder, Dr. Sturtevant points out the importance in the breeding of dairy cows of keeping to the proper type of udder. Thus, he remarks that, if in breeding Ayrshire cows the breeder seeks to place on the udder the large cone-shaped teats set widely apart, in place of the short cylindrical small-diametered and widely-set teats of the true type, he will be departing from that type, and will therefore not obtain the same results in the dairy produce. Again, if in breeding from Jersey cows, he seeks to have the teats of the form, set, and size of the Ayrshire, he is departing from the true type of the former breed. The following give the final results of the investigation.

*For Butter.* That the globule should be of good size, of uniform size, and should be in abundance; or, expressed otherwise, a large percentage of cream.

*For Cheese.* That the globule should be so small as to remain mixed with the milk under all circumstances; *i. e.*, a white and not a blue skim-milk. That the globule should be easily mixed with the milk again after rising.

*For the Milk Retailer.* That the globule should remain for a sufficient time mixed with the milk, so that an evenness of quality may be maintained during delivery to customers.

The breeding of cows for dairy purposes requires to be carried out with the greatest care, all the more where high-bred or pure pedigree cows are used; for it seems to be admitted by many that high breeding in cows is inimical to their ready breeding and milking qualities.<sup>1</sup> Not that there is anything to prevent the combination of good fattening, breeding, and milking qualities in one and the same cow; but in highly-bred animals the milk-glands are comparatively torpid and weak, so that much of the food material which would go to the formation of milk is devoted to that of fat. On this point the following extract is taken from a "Lecture on Milk," by the late Dr. Voëlcker.

"In the month of September, in 1860, I selected three cows from the common dairy stock and three pedigree Shorthorns. They were kept in the neighbourhood of Bristol, and fed upon good pasture land. I carefully ascertained the quantity of milk, and also the quality. After they had been kept for some time on pasture, the milk was collected. Each cow then received 1 lb. of excellent linseed-cake, and in a week's time the quantity was increased to 2 lb. per cow. I carefully analysed the milk of the common and of the pedigree cows; and, on looking over the results, I find no perceptible difference between the quality of the milk of the common stock and of that of the thoroughbred Shorthorns. Thus the common cows yielded milk which gave nearly four per cent. of butter, and the thoroughbred Shorthorns gave a milk of the same quality within one-fifth per cent. The total amount of solid matter in both cases was the same. When 1 lb. of linseed-cake was given, the quality of the milk was not materially bettered; in both cases milk of the same quality was produced; and the same general remark may be made with respect to the 2 lb. of linseed-cake which was given to each cow. In all these cases the quality of the milk was not improved, whether it were the common cows or the pedigree cows. The quantity of milk produced by the three pedigree cows, kept on grass alone, amounted to 28 pints in the morning and 21 in the evening, making together 49 pints. The common dairy stock produced rather more than 31 pints in the morning and 21 in the evening, making together 52 pints. When they received 1 lb. of cake per cow, the three pedigree cows gave in the morning 26½ pints, and in the evening 22, making together 48½ pints, which was very nearly the same quantity as that produced before. The three common dairy cows produced in the morning 28½ pints, and in the evening 18, making together 46½ pints. When 2 lb. of cake were given to each cow, the three pedigree cows produced 26½ pints in the morning and 21 in the evening, making together 47½ pints; whereas

<sup>1</sup> Regarding high-bred animals being bad milkers it may be noted, however, that at Warlaby, where the cattle are not only high-bred but closely in-bred, as every bull there used during the last 30 years has been of Warlaby blood, a goodly number of the cows regularly rear three calves during the season, and bring them up as well. They first suckle two calves and then suckle a third after the first two are finished off. In reference to this matter, too, it is worth while to notice that a pure-bred Shorthorn cow—Mr. Deane Willis's Cleopatra 5th—was victor in the two years, 1888 and 1889, at the London Dairy Show; and in the previous year, 1887, the winner was another pure-bred shorthorn, Mr. Edwards's May Duchess 18th. Many of the bluest-blooded Shorthorn and other stock in the country are splendid milkers, although some breeders, it is true, have sacrificed milk to flesh.

the three common dairy cows, with the same quantity of cake, produced 30 pints in the morning and 19 in the evening, making together 49 pints. It follows from this that, whilst the quality of the milk was not materially bettered, the quantity became slightly less, especially in the case of the three ordinary cows. From the three pedigree cows we had 49 pints of milk per day with grass alone, with 1 lb. of cake per cow the quantity was  $48\frac{1}{2}$  pints, and with 2 lb. of cake it was reduced to  $47\frac{1}{2}$ ; from three common dairy cows, fed on grass alone, we had in the first instance 52 pints per day, with 1 lb. of cake the quantity was reduced  $46\frac{1}{2}$ , and with 2 lb. of cake it was 49 pints; it would appear from this that the additional food evidently had a tendency to go into meat or to produce fat."

Generally, with regard to the breed of dairy cows, it should be remembered that the breed of any locality may be improved by selecting the heifers of the best milkers, and breeding with these by bulls also obtained from the best milkers. And to enable the "best milkers" of a herd to be known, we should strongly recommend a systematic dairy account to be kept, in which the name, age, and all peculiarities of each cow are put down in a book, with a series of columns given to this cow's register, in which the results of the mornings' and evenings' milkings are carefully entered. Another advantage arising from this plan would be that the effect of any system of special feeding could be at once noted. The method of recording a milk register is described on page 245.

The suggestions contained in the foregoing paragraph are admirably emphasised in a paper on "The Breeding and Selection of Dairy Cattle," which was read by Mr. Henry Simmons, of Bearwood Farm, Wokingham, at the Eastern Counties Conference of the British Dairy Farmers' Association, in 1888. From it we take the following extracts:—

"It is admitted by all, however prejudiced we may be to our own particular breed or fancy, that good cows are to be found in all breeds of cattle, although they are less common in some breeds than in others. This arises from various causes, and may be due in some measure to the country, climate, soil, and the nature of the food; at the same time, I think that more is left with ourselves in the formation of good cattle by judicious thought and management than may at first sight appear to the casual observer. The first question is—What constitutes a good cow? The answer, I think, must be—The one that is the most profitable, rent-paying animal, looked at from all points. I do not purpose in this paper to go into the merits of the respective breeds of cattle, but rather to state from my own observation and experience what I think the best and most likely system to produce good cattle from any given breed. I do not like to hear any man or newcomer into a district set up his opinion too decidedly against the usages of that district, or to so run away with his own ideas or fancy as to drive on headlong in the belief that some particular breed is the best for all soils and climates. Such a man, and we often meet with him, generally, unless he sees his error in time, comes to grief.



“The great and chief object is to obtain a cow that is a heavy milker, but you must obtain this without sacrificing form, size, or quality. This, I firmly believe, can be and is now extensively done, and reduced almost to a certainty, by careful selection and using fresh strains of blood. If the Shorthorn breeders, by losing sight almost altogether of milk (as, I think, it must be allowed many of our leading men did), and looking only to colour, hair, and form, produced the grandest beef-making animals perhaps the world ever saw, but as a rule very deficient in milking properties, it stands to reason that, by giving our attention solely to milk, the opposite result will necessarily be obtained. To push either of these systems to the extreme is bad, we want the two so blended together as thereby to produce milk, form, and constitution. The fact that many of our most prominent breeders do now carry out this practice is evidenced by the great demand for their young bulls; purchasers knowing that in their management and selection these objects are kept steadily in view.

“In starting a herd, no matter of what breed, it is necessary, after selecting the cows as carefully as circumstances will admit, to use only bulls from dams of known good heavy milking properties. Having done this, then carefully note the quantity and quality of the milk given by each animal; this can be done by weighing the produce given by them respectively, say one day in each week. Then weed out from time to time for disposal as beef, or otherwise, all failing to reach such a standard as is considered profitable and satisfactory. Care and some patience are necessary in the case of heifers, as, although bred from known milking strains, they will sometimes, from various causes, do badly with their first calf, but when rightly descended they generally repay you with the second calf.

“Should it be found that the herd is leaning too much to milk, and losing flesh, form, or constitution, or *vice versâ*, then make such an alteration in the selection of the next bull used as is calculated to remedy the defect. I do not for a moment lose sight of the fact that with the greatest care mistakes may be made in the sire used that will take some time afterwards to rectify, but this, I think, is only the exception to the rule, and that by following the plan I have stated success in the main will result.

“Having secured a good cow, the next thing is to take care of her, and this will never fail to be well done by any man who has given the thought and attention required, as before stated, to get her. It must follow as a matter of course. The herd should be liberally and regularly fed with nutritious milk-forming food, and thoroughly milked out twice daily at stated times, and above all, supplied with pure water and kept clean. The plan of allowing the calf to run with the dam is bad for milking results, the better system being to rear the calf by hand at a week old.

“The cow-calves will be reared, excepting those of bad form or colour and from unsatisfactory dams, and passed in due time into the herd with their first calves when about two-and-a-half years old; the bull-calves in ordinary herds being sold at a week old, or steered for

feeding purposes. Even in some, if not most of the pedigree herds, steering might be practised more than it now is with credit to the breeder and profit to the dairy interest—a proportion of those we see annually put up for sale make bad bulls, but would find ready purchasers as oxen.

“Some years since, at Bearwood, we had a cow, a cross between Jersey and Shorthorn, but favouring most the Jersey breed. She was first prize cow in her class at the London Dairy Show, and took also a milking prize, in addition to various prizes at other shows. I mated her with a very heavy-fleshed Shorthorn bull, ‘Caractacus’ (36815), bred by Mr. Joseph Stratton, whose father first started his herd from extraordinary milking cows, and she produced in course of time three cow-calves in succession, all of which took prizes at the ‘Dairy,’ ‘Bath and West,’ and other shows, and, although of grand shape and form, proved remarkably heavy milkers and of excellent quality. The second calf she bred I entered at the London Dairy Show as in calf; she was passed by the judges as by far the grandest heifer in the class, but doubtful as to being in calf, and showing only beef-making qualities. This heifer calved to the time stated, and was a grand milker, thus proving that although they all three took their sire’s immense frame and substance (he weighed dead 240 stones of 8 lb.) they still retained the dam’s milking powers, in which, I believe, the sire played his part. This appears to me to be the class of animal, pure or crossed according to fancy, most likely to pay the owner for her keep, and leave something towards the rent. One that will do good work at the dairy, and make beef afterwards. A pure breed should be the chief aim, as crosses often do well the first time, but are very difficult to carry on. Will our Channel Island cattle breeders do well to follow exclusively, according to show yard dictum, the system of breeding to produce a mere milking machine of delicate constitution, or will they not do better to make our English bred cattle of those valuable breeds combine, in some degree at least, the before-mentioned qualities of milk and beef making frame? To please a lady’s or gentleman’s eye and grace the park is one thing, but to pay rent and earn a living out of them is altogether another and more difficult matter.

“One very serious drawback I have experienced in keeping fleshy cows, giving a large quantity of milk, has been from the disease known as the “drop” after calving. I have, both in our Jersey, Shorthorn, and Devon herds, for years suffered loss from this cause—more frequently with the Jersey and cross bred, than Shorthorn or Devon cows—many of our cows as they increased in years falling victims to this complaint. I have no doubt feeding for exhibition has increased the risk; at the same time, we have lost them in all stages of condition, and in the Jersey herd more particularly, from which we never exhibit. I have called in, with very little success, the assistance of many different veterinary surgeons; tried scores of so-called certain remedies and cures, both allopathic and homœopathic, before and after calving, including whiskey and other alcohols, but in two cases out of three we have had to kill the animal. About two years ago I was mentioning

this to a very large dealer in cow cattle, and, he said, 'you kill them by kindness; do as I do, I calve some hundreds of cows yearly, and never by any chance lose one from that cause.' He said, 'we let them calve in the grounds, or straw yards, where they chance to be, take no heed of them, only collect the cows and their calves once a week for market, and there the matter ends.' I have since adopted the same plan, not even milking them before or after calving, but simply leaving them for three or four days with the calf, letting nature take its own course before bringing them into the dairy. I have lost but one cow under this treatment, and I afterwards found my orders had not been carried out in her case. I merely state this as a fact in our own herd, to be taken by others for what it is worth.

"On looking through many large herds of cattle, and hearing the owners complain of bad results from them, one cannot help seeing that much improvement may even yet be made by a little more care and thought in selection. The large sales of young pedigree stock, now constantly held in all parts of the country, by giving farmers an opportunity of obtaining a suitable bull for their respective herds, instead of using an animal of chance breeding, are doing much to rectify this evil."

Although the cow may be supposed to arrive at puberty at the end of eighteen months or even earlier, it is, in many circumstances, not considered advisable to put her to the bull before the age of twenty-two months, or even two years. Much, however, depends upon the breed, the treatment, and constitution of the heifer. It is said by some breeders in the northern part of the island, that young cows may be sent to the bull as early as even *one year* old; but there would then be much danger in calving; and, although the practice might certainly be an essential improvement where the dairy constitutes a primary object, provided their growth did not become stunted, it is generally and properly considered injudicious. Either the mother or the offspring, or both, must materially suffer.

As a matter of fact, however, with cross-bred stock it is a general practice to allow the heifers to take the bull by the time they are 6-quarter old, *i.e.*, 18 months. Thus the early calves of the one year are allowed to take the bull by midsummer of the following year, and so come to the calving at  $2\frac{1}{4}$  years old. The same plan is largely followed with many pure-bred herds. Thus the champion of the Galloway breed at the Royal Agricultural Society's Show at Windsor in 1889—Mr. Cunningham's Maggie of Tarbreoch—was five years old at the date of the show, and she had had four calves before then, and her calves, without exception, obtained a show-yard record second only to her own.

A notion formerly prevailed, and is not even yet entirely exploded, that the best mode of improving stock, of every description, was to choose males of the largest size. The result, however, is generally a great increase of bone without any corresponding improvement in other qualities, and such an incongruity of shape as evidently denotes a mongrel breed. The most judicious method is, to employ males of

superior shape, but yet of a suitable size, and to couple them with females nearly as large, if not larger. The nearer the complementary qualities of both approach to perfection, the better will it be for their progeny; but it is material that, even in their best points, there should not be too great a disparity. Gradual improvements will always be followed by certain ultimate success, while violent attempts to effect a sudden change will invariably disappoint expectation.

The most advantageous time, generally speaking, for a cow to *take the bull* is, from the commencement of May until the middle or close of July, so that she may calve in January, or not later than March or April; and as it is in most places a matter of considerable importance to have a uniform supply of milk throughout the year, it would prove a source of profit, to a farmer possessing a considerable number of cows, so to arrange the routine of breeding as to have three or more cows dry at all times.

But cows may and do calve at all seasons of the year. Hereford breeders generally contrive that their cows shall calve about Christmas or a little before. The Highland breeds are arranged so as to calve about April, or early in May. Heifers should calve about this time, as the spring grass is very beneficial to their milk; older cows may calve early in the autumn. In short, it is a matter for the consideration and convenience of the farmer, and not one on which special rules can be laid down.

The period of time during which cows are allowed to *run dry* previously to calving is by no means settled. By some farmers they are recommended to be laid dry when they are about five or six months gone with calf; but repeated and successful experiments prove that six weeks or two months are sufficient for this purpose; indeed, cows kept in good condition are sometimes milked until within a fortnight of calving. This, however, is a practice not to be recommended; for if the cow *springs* before she is dry, serious injury may ensue.

The usual symptoms of the approach of parturition are *springing*,—*increased size of the udder*; also enlargement of the bearing, and a glairy discharge from it; a sinking or leanness between the udder and the bearing, a decided depression on each side of the rump-bone, with evident uneasiness, and sometimes repeated moaning. Waxy matter on the teats is also a sign of approaching labour. The cow becomes more and more restless—lying down and rising again, often looking towards her hind parts, and frequently lowing at intervals. She must then be supplied with plenty of litter, to protect the calf from injury. To a certain extent, also, she must be watched; in other respects, everything is left to nature. Some cows bring forth standing, and others lying down.

In general the cow *conceives* after once taking the bull; but, if she should chance to fail, she should be put to the bull the next time she comes in season (or “heat,” or “use,” as it is variously termed), and so on till she settles to the service.

The desire of having a full supply of calves has induced many breeders to have recourse to *artificial means*, in order to make cows take the

bull—a measure which cannot be too much deprecated, for the most efficacious mode of obtaining this object undoubtedly consists in keeping them in good heart. The time when a cow is in season, is known by her restlessness, or her riding on other cattle; and by an inflamed appearance of the external parts, accompanied by a discharge from the vagina. These symptoms, generally, do not continue more than about 24 hours, and do not return till the expiration of 20 or 21 days. When conception has taken place they disappear.

The *period of gestation*, or the time during which the cow goes with calf, varies much. A bull calf usually goes about forty-one weeks, with a difference of a few days either way; a cow calf coming in less time. From 282 to 285 days may, therefore, be assigned as the average period of gestation. At the close of this period the cow usually produces one calf; though instances sometimes occur when two, or even three, are brought forth. It may not, however, be useless to remark, that some cows are naturally *barren*, and this is said to be the case when a male and female calf are produced at the same time. The male animal is perfect in all respects; but the female, which is denominated a *free marten*, is, generally speaking, incapable of propagating her species. There are, however, a few instances on record of her breeding. She does not differ very materially, in point of form or size, from other cattle, though the flesh is erroneously supposed to be greatly superior in flavour and fineness of the grain.

The late Earl Spencer has left us data as to the period of gestation in the cow, founded on observations on no less than 764 of these animals.<sup>1</sup> He says:—

“The shortest period of gestation when a live calf was produced was 220 days. Any calf produced at an earlier period than 260 days must be considered as premature, and any period of gestation exceeding 300 days must also be considered as irregular.”

He states that, out of the 764 cows he observed, 314 calved before the 284th day and 310 after the 285th day, thus showing that the average period of gestation is about 285 days, as above stated on the authority of Mr. Torr, who was an eminent breeder of Shorthorns in Lincolnshire. It is a generally received opinion that when the period of gestation exceeds forty-one weeks a bull calf may be expected, and observation and experience have demonstrated that there is some foundation for this belief.

As cows are very subject to *abortion* (see page 557) when improperly treated during gestation, they ought to be watched with more than ordinary care through the whole of that period, and particularly the latter portion of it. The principal causes of abortion are violence or accidents, too good or too poor condition, hereditary predisposition, some epidemic or other influence; and last, though not least, contagion, or a tendency to *slip the calf*, being propagated from one cow to another. Ergoted grasses, which are often to be found in ditches and swampy places, in wet seasons, are probably one of the causes of

<sup>1</sup> “Journal of the Royal Agricultural Society,” vol. i. 1st series, p. 165.

abortion amongst cows. The grain of these grasses exhibits an abnormal development, having been converted by a fungus into a purplish-black structure. Various grasses are subject to it,—Timothy, Foxtail, Dogstail, Cocksfoot, Rye-grass, Meadow Fescue, and Sweet Vernal, besides the grasses indigenous to swampy places, and various others which are regarded as weeds (*see* page 926).

It is a matter of prudence, or almost of necessity, to separate the cow that has slipped her calf from the rest of the herd; and it should not be forgotten that cows that have once slipped their calves are more liable than others to a recurrence of miscarriage.

For about a month or six weeks before the time of calving it will be advisable to turn the cow to grass, if in the spring; but if it happens to be winter, she should be fed with the best hay, and some turnips, potatoes, carrots, or other winter fodder, or a mixture of bran and oats or bean-meal, to which grains may be sometimes added. Should these not be at hand, the mere boiling of a portion of her hay, and giving it with the water, when cool, will be found to keep the body in a healthy state for calving, and also improve her milk. It is not desirable that she should be fattened, because the fatter the cow is, the less milk she gives, and yet, if she is too poor, there is danger lest she should drop in calving. The middle course between these two extremes is the best,—enough to keep the cow in good condition, but no more. Give her access to good “store” land, and let her find her food.

The following note from the pages of the “Scottish Farmer,” in connection with the point now under discussion, will be worthy of attention here:—

“The cow cannot, on the whole, be regarded as a troublesome animal to manage, but not unfrequently there are morbid states which have puzzled the farmer and veterinarians not a little. Thus, abortions are common, and under other circumstances we find young animals manifesting parturient pains before their full time, which causes no little anxiety to the stock-owner. Solitary instances of such premature efforts are apt to be mistaken, and if the mouth of the womb is explored it is found closed and firm. We have often observed violent straining under the circumstances, and the foetus pushed up above the neck of the womb. Not unfrequently such cases are improperly taken for abnormal indications of the mouth of the uterus, and this is forcibly opened or cut, parturition is brought on, and the cow not infrequently dies. Early interference in all such cases is very injudicious, and if travelling or other cause of excitement has disturbed the cow, it may be advisable to give a purge or feed lightly, and to wait. In the large majority of instances, two or three days pass over, when proper efforts come on, the parts become dilated, and a fine healthy calf is born. It is very rare to have much disease about the mouth of the womb, which would interfere with a birth; whereas the false labour pains are very common. It is a rule in all obstetric operations that it is best to interfere little; and in many instances in which a cow has not been delivered at her time, a calf has been found piecemeal in a state of

putrefaction, or has remained in the womb to dry and mummify, without producing any general disturbance."

When the term of gestation is nearly complete, the animal should be kept near the homestead, in a quiet close, apart from other cattle, in order that she may be under constant observation, and that assistance may be ready in case of a difficult birth. As the final period approaches, measures should be directed, by means of laxative drinks, to avoid constipation. Bran-mashes are the best, the fodder being diminished in quantity. Oil-cake for two weeks before calving, say 2 lb. per day, will also be beneficial. If the cow should be so much exhausted in calving that the throes are not sufficient to produce the birth, she should have a drink composed of gruel, treacle, and salts, 1 lb. of each, and  $\frac{1}{4}$  oz. of ginger may be added with advantage. Cows sometimes calve in a recumbent posture, and care must then be taken that the place at which they lie down is not on a steep descent, for in such case the calf is apt to be brought prematurely forward, and, by the straining and irritation which this produces, a tedious and sometimes dangerous calving is occasioned. When, however, the act of calving has actually commenced, the operation will be aided by the animal being placed on a gentle descent.

Calving is sometimes attended with difficulties arising from the bad position of the calf in its mother's womb (false presentation). This evil may be greatly diminished by skilful and judicious aid. The first thing to be done, in such a case, is to obtain an exact idea of the position in which the calf should be placed, and its actual deviation from that position. By gently thrusting the hand into the womb, this deviation may not only be ascertained, but in most cases corrected by turning the calf. The usual cause of resistance is a false position of one of the fore-legs, or of the whole body, in consequence of which the forehead shows itself instead of the muzzle. Force must no more be applied in this case than it would be to make anything pass into the gullet. Any violent traction may be fatal, where nature will assist if we will only give her time. All assistance given must be guided by discretion. Misdirected aid may do an infinite amount of mischief, and is too often fatal. As, however, this is not the place for teaching the obstetric art, we pass it over, strongly recommending all farmers who pay any attention to their cattle to avail themselves of every opportunity of acquiring information on this matter, since in the country it is not always possible to obtain at short notice the assistance of skilful veterinary surgeons. In other respects, however, it is best to leave all to nature and chance; for without proper knowledge we shall be more likely to kill the cow with her calf than to save her.

About half, or at most three-quarters, of an hour is the ordinary time occupied by actual labour in the cow.

After a cow has calved she should be left quietly with her little one, in case the latter is allowed to remain with her. Many breeders, however, take the calf away at once, and the cow sees it no more. This is, perhaps, on the whole, the best system to pursue, save in cases where a heifer has her first calf and her udder is hard,—

“hogged” is the term in some districts,—for then the sucking and butting of the calf are useful in getting rid of it. A warm mash should be given, and water slightly warmed. In fine and dry weather the cow should be watched attentively, in case she should require aid, but no artificial means should be used, unless she evidently needs assistance. On the following day she may be turned out about noon, and regularly taken in during the night, and this for three or four successive days.

The above hints are given on the supposition that the cow is well, and that no difficulty has happened during the time of calving; and particularly that she has not *slipped* or *cast her calf* before its full time. It should be observed that the proper position of a calf while in the uterus is with its head foremost, its back being towards the cow's back, and its two fore-feet lying parallel to the sides of its head. When the fœtus appears in any other manner, it is termed an *unnatural position*; and the extraction of the calf under these circumstances may require some skill and dexterity: but as no instructions can be adequate to every possible case, it will always be necessary, when this event takes place, immediately to apply to a veterinary surgeon, lest the death of a valuable animal should be the consequence of injudicious treatment.

After the calf is produced, it will sometimes be necessary to assist the natural functions of the animal in removing the *secundines*,<sup>1</sup> provided in the uterus for nourishing the fœtus, and which, continuing there after the birth, would become putrescent, and produce irritation in the womb, and probably considerable fever. There is no danger, however, that this will immediately take place, and a few days will pass before any material inconvenience will ensue. No attempt should be made hastily to remove it, without there is evident inconvenience or danger from its retention. An aperient drink, composed of a pound of Epsom salts and a quarter of an ounce of ginger, will always be useful after calving.

It may be necessary to milk the cows three or four times a day for two or three days, especially if they are full of flesh and the udder is hard. The calf should be suffered to suck frequently, if in the house; or, if in the field, to run with the mother, and suck at pleasure: it being carefully ascertained that she does not prevent it from sucking, for, if the udder or teats are sore, she will probably drive it away, and danger of losing both animals will be incurred. Should the udder or the teats become hard, or knotty, or tender, the most easy and effectual remedy will be to let the calf derive all its nourishment by sucking. In a great majority of cases the indurations will gradually disperse. Should, however, ulceration of the udder, or general fever, ensue, the cow must be treated as described under the Diseases of Cattle (Book the Sixth).

The falling down of the calf-bed is a serious accident, which sometimes occurs after a laborious birth, when the cow is more than usually

<sup>1</sup> Or afterbirth, sometimes termed the *cleansing*. Cows will often eat this with avidity, to prevent which it is generally removed. This practice is, however, of doubtful utility, for nature seems to have provided in this substance a kind of medicine for the animal, which may be requisite at the time, and its being eaten is never known to be prejudicial to the health of the cow.



fatigued; some beasts, however, are naturally disposed to this weakness. The placenta, or cleansing, should be first removed, after which the operator may replace the calf-bed as gently and as quickly as possible, and secure it in its situation by the application of *proper bandages*. This likewise demands, in the majority of cases, the assistance of a well-educated and skilful practitioner. The animal should afterwards be kept as quiet as possible. Opium, or febrifuge medicines, as nitre and fox-glove, with gruel and mashes, may be administered; but the stimulating drinks too often given in these cases must be avoided, as pregnant with the greatest danger.

When the calf-bed comes down, and no immediate aid can be procured, it should be deposited on and covered with a clean linen sheet; the irritation thereby produced being considerably less than that of the air, litter, &c. Before it is replaced, the parts that have been so exposed should be well cleansed with warm water, to which, if there be much bleeding, or any appearance of mortification, a little spirit may be added.

*After calving*, the cow should not be permitted to take the bull until four or five weeks have elapsed, although she may exhibit symptoms of bulling sooner. The womb is, during that time, in so relaxed a state as seldom to admit of conception.<sup>1</sup>

In high-class dairying the object, so far as the cows are concerned, is two-fold: first, to obtain the largest yield with the highest quality of milk; secondly, to keep the cow in such a way that, while this the first object is gained, she will be maintained in good condition; so that either when "dried off" or set aside from dairy purposes she will be ready for the butcher, or can be quickly made so.

These two objects were for long, and indeed are now by many, deemed incompatible; so that all that was aimed at was to get as much milk as possible out of the cow in a given time, and then send her off to the butcher "for what she would bring." Under the improved and modern system of dairying, it is found that the two objects are quite compatible, and that they can be secured.

To succeed in this, considerable knowledge and skill are required, and no small amount of patient painstaking care. In the first place the animals selected should be first-rate milkers, this being the primary point; but as they have to be sold to the butcher in good condition, some of the points of fattening beasts must be found in them. But while the latter features must not be neglected, the primary object, as stated above, is to get milkers of the first class.

It is right, however, to state that there are those, and eminently good dairymen too, who hold that dairying, for the double purpose of getting the maximum of milk both as regards quantity and quality, together with beef-procuring capacities, cannot be carried on at a profit,—that just as you secure the one, so in like, or perhaps even in greater, proportion, you lose the other. They therefore answer in the negative question,—Can we get a breed which will yield at once milk and beef in the highest

<sup>1</sup> See "Skellett on the Parturition of the Cow," which contains much valuable information on the subject of difficult births.

degree? In truth, this question is surrounded with difficulties; but, as we have just now said, improved practice has shown that they can be obtained in the same animal.

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## CHAPTER VI.

### ON THE TREATMENT AND REARING OF CALVES.

THE importance of bringing calves to an early maturity, with the fullest development of their best qualities, has naturally excited the attention, and employed the ingenuity, of the most expert breeders. The best general plan is to adhere as closely as possible to nature; but as various modes of treatment have been adopted, we will endeavour to bring into one view the most useful facts connected with this subject.

After the calf is produced, the cow almost uniformly shows an inclination to cleanse it by diligently licking off the slimy matter adhering to the young animal; and this she should be allowed to do without the slightest hindrance. It is a very bad practice to give gruel to the calf soon after birth; the colostrum, beastings, or first milk drawn from the cow, will be the best thing that can be administered. It is seemingly provided by nature as the first aliment of the newly-born animal; and is not only intended for the purpose of early sustentation, but, by its mild aperient quality, it carries off the fæces that had been accumulating in the intestines of the fœtus during the last months of its intra-uterine life.

There are two modes of rearing calves:—one is, to permit them to run about with the parent cow during the first season, or a part of it; the other is, to remove them when born, and bring them up by hand.

Whether calves are designed to be raised for breeding, labour, or fattening, care should be taken that they have a sufficient supply of good food; for if the quantity is scanty at first, the animal will rarely, if ever, attain a considerable growth. The best time for weaning them is about that period of the year when the young grass acquires succulence enough to entice the appetite, and to afford complete nourishment without the aid of milk. Calves that are dropped in October or November will thrive rapidly upon the nourishing pastures into which they may be turned in the ensuing spring, if they have been allowed to suck and have been properly sheltered throughout the winter; but the milk is often too scarce at that season to be usually bestowed upon them; and *winter-weaned* calves seldom arrive at much perfection. Calves will do better in the house, with the cows brought up twice or thrice a day to suckle them, as by this system a greater number of calves may be reared from the same number of cows.

Various plans have been suggested and tried with considerable success, for rearing calves without any milk, or at least with only a small quantity. The time of weaning them varies, from a fortnight until they are seven weeks old ; but the latter period is preferable, on account of the weak and tender state of the calves, if separated from the dam at an earlier age. When skim-milk is used, boiled linseed is found to be an excellent substitute for the cream which has been removed. Various kinds of meals and condimental foods, specially prepared for calves, have been invented ; but, while some of them are undoubtedly useful in moderation, none of them can be regarded as a complete substitute for milk.

In several counties of England calves are left with the cow for about ten days or a fortnight, and, being taken from her, are taught to drink first new milk for a week or two, then new and skim-milk mixed ; and if after a month or so the calf seems thriving, skim-milk only is given, with oat or barley-meal, or crushed linseed, at first in small quantities, but gradually increased in proportion to its age and growth. Some patience is required in teaching calves to drink. When the animal has fasted two or three hours, the first and second fingers of the right hand, being previously well cleaned, are presented to its mouth. It readily takes hold of them, and sucks eagerly. In the mean time, a vessel of lukewarm milk is placed, and supported by the left hand, under the calf's mouth ; and, while the young animal is sucking, the right hand is gradually sunk a little way into the milk, so that the little creature may suck up a sufficient quantity without its nostrils being stopped. If, either from accident or from too sudden precipitation of the hand into the milk, the calf should let go its hold, the attempt must be repeatedly renewed until it is crowned with success. It is much easier to teach a calf to drink from a pail, if it is not allowed to suck at all from its mother's teats, and it must be admitted that this plan is followed with entire success in many dairying districts. Feeding pails, with artificial teats of india-rubber, have been tried, but we are unable to report any marked advantage from their use.

Small wisps of fine hay are then placed within reach of the calves ; these they begin by sucking, and gradually become induced to eat. Turnips chopped small, or carrots, and good sweet hay, may next be given them : and, when they eat well, linseed-cake and crushed oats may be added. They should be liberally fed for the first six or eight months, well housed, and kept warm and clean.

In the county of Suffolk calves are usually weaned soon after Christmas, when they are fed with lukewarm skim-milk and water, having bran or oatmeal in it, and some very sweet hay until the grass is ready. Carrots form an excellent article of food.

About three quarts of new milk daily are sufficient for the support of a young calf. It should be given regularly at stated hours, and the calf should be kept as quiet as possible, for rest will be found materially to promote its growth. The quantity of milk required will vary with the age and vigour of the calf, and should be regulated accordingly. Most calves are greedy drinkers, and they should therefore never be

allowed to take all the milk they would like. Over-feeding is a fruitful cause of intestinal disorders.

In Ayrshire, calves intended to be reared for dairy cows are fed on milk for the first four, five, or six weeks, and allowed four or five quarts of new milk a day. Some farmers never give them any other food than milk while they are young, and lessen the quantity when they begin to eat grass or other food; this they generally do when about five weeks old, if grass can then be had. The milk is wholly withdrawn about the seventh or eighth week. If calves are reared in winter, or before the grass rises in spring, they must be supplied with milk for a longer period, as a calf will not so soon learn to eat hay or straw, or thrive so well on this alone as it will on grass. Other farmers feed partly with meal after the third or fourth week; or gradually introduce some new whey along with the meal, and afterwards withdraw the milk altogether. Hay-tea, linseed-jelly, oat- and wheat-meal porridge, treacle, &c., are sometimes used with advantage; but milk, when it can be spared, is by far the best as well as the most natural food.<sup>1</sup>

Where the supply of milk is small, the following plan is recommended by a writer in the "Irish Farmer's Gazette":—

"Rearing calves without some portion of milk should not be attempted; but with some milk good calves can be reared as follows:—On three qts. linseed-meal and four qts. bean or pea-meal pour 30 quarts boiling water, cover up well for 24 hours, then pour it into a boiler holding about 30 quarts more of boiling water; give it half an hour's boiling, stirring it well all the time; then put by for use, giving it to the calves milk-warm, mixed with milk. The calf should get its dam's milk for the first week, when the mucilage may be mixed with it, at the rate of one-third mucilage to two-thirds milk, gradually increasing the mucilage and decreasing the milk till the seventh or eighth week, when the milk may be entirely withdrawn. For the first week the calf will require between four and five quarts a-day of milk; the second week, six quarts mixed milk and mucilage; third week, seven quarts; fourth, eight quarts; fifth, nine quarts; sixth, ten quarts; seventh, eleven quarts; and so on, increasing one quart a-day per week till it is between three and four months old, when it may be weaned. Hay-tea, made by pouring boiling water, on sweet, nutritious hay, is an excellent addition. If you have no milk to begin with, it would be better to leave calf-rearing alone."

Another mode of rearing calves was suggested by the late Duke of Northumberland, the design of which was to render the use of new milk unnecessary, while the expense was reduced to a very considerable extent. It is effected in the following manner: "Let half an ounce of common treacle be well mixed with a pint of skim-milk; then gradually add one ounce of finely-powdered linseed oil-cake, stirring it until the mixture is properly incorporated, after which it is to be added to the remainder of a gallon of milk. The whole, being made nearly of the temperature of new milk, may then

<sup>1</sup> "Aiton's Dairy Husbandry," chap. i. sect. 4.

be given to the animal. After a short time the quantity of pulverised oil-cake may be increased. This method is said to have been advantageously adopted. Lord Egremont used linseed-jelly in the proportion of one pint to a gallon of skim-milk, without treacle, but it did not answer."

Mr. Beamish adopted the following plan as a substitute for milk in the rearing of calves :—

Thirty quarts of boiling water are poured on three quarts of linseed-meal and four quarts of bean-meal, all then close covered up; and, at the end of 24 hours, added to 31 other quarts of boiling water then on the fire, being poured in slowly to prevent lumps, and being well stirred with a small, flat, shovel-shaped board, perforated with holes, to produce thorough incorporation. After 30 minutes' boiling and stirring, the mucilage is put by for use, to be given blood-warm to the calves as soon as they are three days old; first in equal portions with new milk, increasing gradually to two-thirds, as the calf gets older, substituting skim-milk after a month, and feeding on mucilage alone after six weeks. This mode of feeding will be as follows, viz. :—

Weeks	New milk Quarts	Skim milk Quarts	Mucilage Quarts	Total per Week Quarts
1st . . . . .	22	...	10	32
2nd . . . . .	21	...	21	42
3rd . . . . .	20	...	29	49
4th . . . . .	20	...	36	56
5th . . . . .	...	20	43	63
6th . . . . .	...	20	50	70
7th to 15th . . . . .	...	...	756	756 (9 weeks)
	83	40	945	1068

The following is from the "Farmer's Magazine," the writer stating that he has reared calves successfully, for many years, on this system :—

"Two gallons of water are made to boil, and then a pint of fine flour is mixed with cold water, sufficient to make it into the consistency of thick cream. This is thoroughly mixed, and put into a bowl capable of holding half a gallon; a small quantity of hot water introduced into the mixture, and stirred, so as gradually to decrease the temperature of the flour and water in the bowl, will prevent it running into lumps. This is plunged again into boiling water, and stirred until the whole again cools. This coagulates the mass, and forms a thick, nutritious porridge. It is a great advantage if one-sixth part of cold skim-milk is then plunged into the mixture, which not only gets scalded itself, but very materially improves it. Two gallons of the mixture per day will be found generally sufficient."

An infusion of hay, or sometimes of pea-haulm, called hay-tea or hay-water, has also been used for the purpose of rearing calves with the smallest quantity of milk; but it is not generally efficacious. In order to make this infusion, such a portion of fine, sweet hay, cut once or twice, is put into a small earthen vessel as will fill it on being lightly pressed with the hand. The vessel is then filled with boiling

water, and carefully closed. At the end of two hours a brown, rich, and sweet infusion will be produced, in appearance not unlike alewort, or strong tea, which will remain good for two days, even during summer. It is to be used in the following manner :—

“At the end of three or four days after a calf has been dropped and the first passages have been cleansed, as already recommended, let the quantity usually allotted for a meal be mixed, consisting, for a few days, of three parts of milk and one part of the hay-tea : afterwards the proportions of each may be equal; then composed of two-thirds of hay-tea and one of milk; and, at length one-fourth part of milk will be sufficient. This preparation (the inventor of which was, many years since, honoured with a gold medal by the Dublin Society of Arts) is usually given to the calf in a luke-warm state every morning and evening; each meal consisting of about three quarts at first, but gradually increasing to four quarts by the end of the month. During the second month, besides the usual quantity given at each meal (composed of three parts of the infusion and one part of milk), a small wisp or bundle of hay is to be laid before the calf, who will gradually come to eat it; but if the weather is favourable, as in the month of May, the beast may be turned out to graze, in a fine sweet pasture, well sheltered from the wind and sun. This diet may be continued until towards the latter end of the third month, when, if the calf grazes heartily, each meal may be reduced to less than a quart of milk with hay-water; or skim-milk, or fresh butter-milk, may be substituted for new milk. At the expiration of the third month the animal will scarcely require to be fed by hand, though, if this should still be necessary, one quart of the infusion given daily, and which during the summer need not be warmed, will be sufficient.”

The economical mode above detailed has been adopted in some counties of England, with the addition of linseed-cake finely pulverised and boiled in the hay-tea to the consistence of a jelly, without employing any milk in the mixture.<sup>1</sup>

In Devonshire the method commonly followed in rearing calves is very similar. The greatest number are usually dropped between Candlemas and May, and some much later; but the most experienced breeders prefer the early ones. They are permitted to suck as much as they like three times a day during the first week or ten days, after which they are suckled by hand, and fed with warm new milk during three weeks longer. They are then fed, during the two following months, twice a day, with as much warm skim-milk as they can drink;

<sup>1</sup> In the “Letters and Papers of the Bath and West of England Society,” vol. v., we have a singular instance of success in this mode of rearing, by Mr. Cook. In 1787 he bought three sacks of linseed, value 2*l.* 5*s.*, which lasted him three years. One quart of seed was boiled in six quarts of water, for ten minutes, when a jelly was formed, which was given to the calves three times in the course of the day, mixed with a little hay-tea. Thus he was enabled to rear, in 1787, seventeen calves; in 1788, twenty-three; and in 1789, fifteen, without any milk at all. He states that his calves thrive much better than those belonging to his neighbours, that were reared with milk. Pot-liquor has also been found an excellent substitute for milk; and it is well known that the great ox bred by Mr. Dunhill (already mentioned on page 21) was chiefly reared on it.

with this some feeders mix a small portion of finely-powdered linseed-cake or meal. After this the meals of milk are gradually abated, and, at the end of four months, the calves are wholly weaned from milk, and fed on hay, chopped roots, oat-meal and other artificial food, until they go to pasture.

In the northern counties of England it is a common practice to give the calves equal parts of milk and sweet whey, made luke-warm; but, as this mode often produces scouring, or looseness, we think the following method, which was a few years since communicated to the public by a spirited and experienced breeder, is greatly preferable. For the first four or five weeks he fed his calves regularly, but oftener than is usually done, with new and skim-milk. At the end of this time they were gradually taught to drink strong water-gruel, consisting of equal parts of bean- or oat-meal, mixed with one half of butter-milk, which was carefully stirred with the gruel, after the latter was removed from the fire. This method of treatment he is stated to have pursued with great success for many years. His calves were uniformly strong and healthy, while everything that could tend to retard their growth was effectually checked.

In the county of Norfolk, calves are fed with skim-milk, in which is mixed a little wheaten flour. They have also chopped turnips in a trough, and some hay<sup>1</sup> in a low rack. As soon as they begin to eat turnips freely, they are no longer supplied with milk; these roots, with the addition of a little hay, furnishing to them both food and drink. The period of raising calves in the above-mentioned county is from Michaelmas to Candlemas; but the time of feeding them wholly with turnips varies according to circumstances or accident.

Towards the month of March, those which are first reared are turned out among the fattening bullocks during the day, and sheltered at night, although, if the weather proves favourable, they are in a few days turned out altogether. In the succeeding summer they are kept on clover, or luxuriant grasses; and, in the following autumn, are sufficiently strong to live in the straw or fold-yard. This circumstance is considered as one great advantage to be derived from rearing calves early in the season, for those that are raised during the spring require two years' nursing.

With regard to artificial foods for calves, it may be accepted as a safe rule that, if their use can be dispensed with and the milk given, it will be the most economical, and in every way the most satisfactory plan. Milk is the natural food of the calf. The "colostrum," or the milk first drawn from the cow, contains an unusually large quantity of albumin, and its use by the calf prevents costiveness, and aids the delicate digestion. "Milk again," says Johnson, "is a perfect food for a growing animal, containing the curd which is to form the muscles, the butter which is to supply the fat, the phosphates which are to build up the bones, and the sugar which is to feed the respiration. Nothing is wanting in it." The "internal organism of the calf points to the use of milk *alone* for the early period of its life, and a careful observation of the most successful practice tends to

<sup>1</sup> Many careful rearers never allow their calves to touch dry hay till they are three months old, as they consider it too indigestible.

confirm this opinion. For the same reason, we may also learn another lesson from the natural habits of the animal—that the supplies of food should rather be moderate and frequent than larger in quantity after long intervals. . . . We find that calves which run with the cow thrive better than others, because they can draw their supplies of milk frequently, and in small quantities—in fact, at such times as they feel the want. . . . No doubt it may be questioned whether this is an economical method, and one desirable for general adoption; but there are cases which render such a course absolutely essential to success; and, I believe, in many other cases the question of economy is too often viewed under the contracted aspect of present cost rather than future return.”

In “The Farm and the Dairy,” by Professor Sheldon, the following practical remarks occur:—“I have found it a good plan, after the first three or four days, to put a pinch or two of condimental meal into the milk given to a calf, and, within reasonable limits, this practice may well be followed so long as the calf receives liquid food at all from a pail. The condiment stimulates digestion, gives a tone to the intestinal organs, and is, as a rule, a safeguard against scour, or undue relaxation of the bowels, which is in many places a cause of much fatality. A handful of oatmeal, carefully dried, is also a good thing to put into the milk after the first week is over, and it will gradually accustom the calf to greater changes of food later on.

“Calves dropped in February or March will, as a rule, be fit to turn out in a croft, in the daytime, some time in May, and they will quickly take to grass as supplementary food. But, before turning-out time comes, they should be taught to eat linseed cake, and this is easiest done by putting bits of it into their liquid food. Now, this linseed cake should be continued until they are a year or fifteen months old,—that is, until they are turned out to their second summer’s grass. Linseed cake, indeed, is the only effectual preventive out of many that I have tried for ‘black-leg,’ on a farm subject to that malady. The quantity of cake young calves will eat, when they are out on their first summer’s grass, is not much—say half of a pound to one pound each per day; but as the autumn wears along they will eat more.”

A well-informed correspondent writing in the “Dumfries and Galloway Courier” (July 2nd, 1890,) states that probably the difference between the richness of the first and second halves of the milk drawn from a cow is not sufficiently taken into account in the practical work of calf-rearing. It is generally known that the “strippings” or portion of the milk taken from the cow just before she is milked dry are much richer than the average. But there is a greater diversity in the quality of the second and first halves drawn than is generally supposed. The following is a brief outline of a system adopted in calf-rearing, whereby it is possible to give new milk to calves, and yet, by reducing the proportion of butter fat in the natural food supplied to them, to have a large proportion of that constituent of the milk available for the manufacture of butter. The plan adopted is this:—At milking-time two large vessels are put outside the byre-door, one marked “Dairy” and



the other "Calves." One-half of the milk given by each cow—viz., that first drawn, is emptied into the vessel marked "Calves," and the other half—viz., that last drawn, is put into the vessel marked "Dairy." This latter half is found on being tested to contain from two-thirds to three-fourths of the cream. The calves have the advantage of being fed with milk warm from the cow, at the same time that they are reared at a moderate cost, as their allowance of the milk does not contain much cream. When the number of calves is so large as to require more than one-half of the milk, the proportion drawn from each cow and emptied into the calves' vessel is increased, and, of course, the quantity available for buttermaking is to that extent diminished. When the calves grow to some age, say in the second month of their existence, they are fed on boiled skim-milk, eight to ten quarts per day; to prevent the milk being burned, the vessel in which it is heated is suspended in a copper of water. From the end of the second month the calf gets a mixture, consisting of two-thirds oatmeal and one-third crushed linseed, made into porridge, and mixed hot with skim-milk. The quantity of mixed meal is gradually increased from one pound to two pounds per day.

The calves should, if possible, be fit to wean in the month of May. Before putting them out to grass, they should be accustomed to the use of green meat; some early vetches, rye, clover, &c., will prepare the stomach for the succulent herbage of the pastures. The weather being mild and the herbage in good condition, the calves should be put out; on young pastures or recently laid down grasses rather than on old pastures. As cold is prejudicial, it will be advisable to shelter the calves at night. A good supply of water and a change of pasture are desirable for the first summer. The calves should be put into the pastures first, the older cattle following and finishing up. The supply of oil-cake should be kept up, to prevent those checks in the growth to which allusion has already been made. In some cases the calves are not turned out, but are reared in well-littered yards and sheds, green food and oil-cake being given to them.

An absurd and thoroughly cruel notion, too prevalent, is that calves are the better for being "roughed," that is, exposed to the severest weather in winter and supplied with scanty food. Mr. Bowly, the eminent breeder, exposed the fallacy of this idea:—

"I have no faith in the idea which I have sometimes heard expressed, that 'roughing' calves (which means exposing them to cold and hunger) makes them hardy. On the contrary, it has the effect of weakening their constitutions; and this system pursued towards the young stock for two or three generations will ruin the best breed of cattle in the country; the offspring after this time will have lost all the quality, early maturity, and propensity to fatten shown by their ancestors, and it will require years of the greatest care to recover what is thus lost." He, however, is careful to notice that it is, on the other hand, "very injurious to force young animals, although it *may* be necessary to those individuals which are intended to compete for prizes. The tendency of such a system is to curtail their useful-

ness as breeding animals; for, though most of them so forced will breed, there is, of course, more risk in calving them, their milking properties are greatly lessened, from those vessels intended by nature for the supply of milk being coated with fat, and they decay prematurely, and have all the marks of age upon them at seven or eight, whereas I have bred from cows not so forced up to twenty-two years of age. The happy medium is the best, where they are kept in thoroughly good condition."

The successful rearing of calves very much depends on the regularity and frequency of feeding them. The common practice is, to supply them with food twice in the day, viz., in the morning and at evening, when they generally receive as large a quantity as will satisfy their craving appetite. Hence the digestive organs are necessarily impaired, and too many animals either become tainted with disease, or perish from the inattention of their keepers; whereas, by feeding them thrice, or even four times, in the day, at equidistant intervals, and allowing them sufficient space for exercise, they will not only be preserved in health, but will greatly improve in condition.

Whatever food is allowed to young calves, care should be taken not to change it too suddenly. A calf should have attained a certain degree of strength before it can dispense with the food most natural to its age, or thrive without the aid of milk: this fluid should therefore be allowed as long as possible. Even when that has been withdrawn, and the animal has begun to eat grass, hay, or artificial food, the milk or the substitutes employed in lieu of it should be partly continued until the calf begins to prefer the pasture. It is a common notion that, provided young stock acquire size, their condition is immaterial; and, after the first winter, they are often turned into the roughest pasture, and kept during the following winter on chopped straw, with, perhaps, a little indifferent hay. This, when they are intended to be sold to the fattening grazier, may be the most profitable mode, and, in some situations, it may be the only one that can be adopted; but, when they are to be reared for the breed, it is absolutely requisite, as the only means of bringing them to perfect maturity, and improving every good quality, that they should be kept on good pasture during the summer, and allowed roots with some sound hay in the winter, and green food in the spring. A contrary mode, however apparently economical, is decidedly disadvantageous; for the worst breed will ultimately be improved by good feeding, while the best will degenerate under a system of starvation.

Of recent contributions to our knowledge of the art of calf-rearing one of the most useful, as it is one of the most practical, is that of the Rev. John Gillespie, which appears in the Transactions of the Highland and Agricultural Society of Scotland, 1890. The author says:—

"Whatever system is adopted, calf-rearing, to be successful, demands not only skill, but above all, careful management and unremitting personal superintendence. Where pail-feeding is followed, the person in charge must be thoroughly reliable, and very painstaking. The food must be given with very scrupulous care and regularity. This is

most important when nothing except the natural food of new milk is given. But where, from the milk being supplemented by other articles, a mixed diet is given, care and attention at every stage are of exceptional moment. If the ingredients are not used in the proper proportions; if the constituents are not evenly mixed; if the right quantity is not given to each calf or at the proper temperature,—when some of these all-important conditions are not complied with, and especially when all of them are neglected, the results cannot but be unsatisfactory. There is an old and a true saying to the effect that nothing conduces so much to the thriving of a horse as the watchful eye of the master, and in no department of farming does this principle hold good in a greater degree than in calf-rearing. Constant supervision on the part of the farmer or some member of his family is simply invaluable. Old and reliable servants are occasionally found who could not be surpassed in this sphere of labour. Where such hired helps are not available, and members of the family are in the habit of taking their share in the work of the farm, by all means let them not consider it beneath their dignity to at least superintend the upbringing of the youthful bovine stock of the farm.

“Calf-rearing can never be said to be successfully prosecuted if the calves are not kept in a healthy, growing, progressive state. To rear calves and starve them is the worst possible policy. In former times when cattle were very slowly brought to maturity, it was considered good management to keep them on very short commons in the earlier months of their existence. And possibly, in view of the poor keep allowed them afterwards, liberal treatment at first would have been thrown away to some extent. But nowadays stock-owners are becoming more alive to the importance and profit of keeping animals, that are intended for beef, well at every stage of their existence. Early maturity is what is now aimed at by all enlightened and enterprising farmers, and it goes without saying that this can only be secured where the beast is kept on a liberal diet from the very first. Indeed it is the truest economy to feed the young calf well. It will make more rapid progress on less food at that stage, when its powers of consumption are necessarily small, than a year or two later when its capacity of consuming food has been greatly increased.

“The most ancient, and, some say, the most successful method, is to allow the calf to run with its dam and be suckled by it. In ordinary circumstances year by year with cows, this plan cannot be commended as a remunerative one. Where the cow supports only her own offspring, the calf is had at weaning-time at the cost of a year’s keep of a cow, which is certainly a high price to pay for a six or seven months’ old beef animal. The only recommendation in its favour is, that it reduces the labour bill to a minimum; but even with every weight that can be attached to that consideration, this must be pronounced an extravagant system of calf-rearing. The case is somewhat changed where a couple of calves are reared by one cow. Where the dams are of fairly good milking strains this is quite practicable, and, indeed, in not a few cases it is followed with results that cannot be considered altogether unsatis-

factory. Where economy in manual labour is a matter of moment, this plan has obvious advantages. We believe that one calf, or at most two calves, might be taken with profit and advantage from heifers on classes of land that are specially adapted for the rearing of young cattle. Two-year-olds, and occasionally extra strong yearlings, might be served in time for the calves to drop as the grass is coming in late spring or early summer. Their own calves might be left to run at their feet until they are, say, three months old, when these might be weaned, and each young cow got to take another in the place of her own. Supplemental food might be given to her from this point, with the twofold object of increasing the flow of milk for the support of the young calf, and of improving her own condition preparatory to her being made fit for the shambles, which she should be during the ensuing winter. She would be marketed for beef at a comparatively early age, and she would have brought up two calves, of one of which she was the dam. If made really fat before being disposed of, she would realise the full value of the best heifer beef, for she would show little or no trace of an udder. We have known of not a few instances in which this system has been followed with satisfactory and profitable results, especially where the circumstances were such as to render it desirable to provide a supply of home-reared cattle, and yet incur a small labour bill. In other cases, a second crop of calves is in the habit of being taken before the dams are made ready for the fat market. But the drawback of this second season's calf-rearing is the danger that the mothers will have an unmistakable cow-like look even after being dried, and consequently sell at the reduced price of cow-beef when they come to be marketed."

The value of Mr. Gillespie's paper is enhanced by the records of sound practice which he quotes from reliable breeders in various parts of the country. Some of these we re-produce for the benefit of our readers, selecting for this purpose four from England, two from Scotland, and two from Ireland.

The mode of rearing pursued by Mr. John Treadwell, Upper Winchendon, Aylesbury, Bucks, though somewhat peculiar, is at the same time very successful. He sells his milk to the Anglo-Swiss Condensed Milk Company, which has a factory at Aylesbury, seven miles from the farm. The class of cows kept are what Americans would term "grade" Shorthorns. The farm is a mixed one of about 380 acres of arable and 760 acres of grass land. In addition to keeping a dairy of cows for milk, Mr. Treadwell rears all his home-bred calves, the heifers being retained as cows and the steers fattened for the butcher. He also breeds Shire horses, and keeps a flock of Oxford Down sheep which has a world-wide reputation. At present Mr. Treadwell is milking 130 cows. These begin to calve in September, the calving season being almost entirely over by the end of January. The cows are liberally fed at all seasons. The Sunday morning's milk, not being sold, is skimmed and the cream churned into butter,—this single meal of skim-milk being largely utilised for the rearing of the calves. Being boiled on the Monday, it keeps during the winter

months quite sweet during the remainder of the week. The newly dropped calves suck their dams for about a week. The following week they are fed upon boiled new milk, about five pints being the allowance given morning and evening. Then for a fortnight the principal diet is skimmed milk, after which a little of Simpson's Calf Meal is substituted in lieu of some of the milk, the one being increased and the other diminished as time goes on. When the supply of skim-milk—obtained as above explained—runs short towards the end of any week, a mixture of new milk and water is substituted in its place. Some oats and mash are given, then oilcake and mixed meal, the quantity being gradually increased until an allowance of about 2 lb. each per day is reached. The calves are got to eat swedes, and so by the time they are ten or twelve weeks old they are weaned from milk and the above calf-meal. They have also hay put before them *ad libitum*. This diet is continued until the grass comes, when they are turned out to some poor grazing land, and get a mixture of about 2½ lb. of decorticated and linseed cake during the summer, which makes them come into winter-quarters in fresh condition. This winter (1889—90) Mr. Treadwell has reared upwards of eighty calves in the manner described. He concludes his valuable communication in the following significant terms: "Cattle, sheep, and horses all graze together, my aim being to breed as many head of each class as I can, and to make fat and sell out as many as I can without buying. I wish to do away with the middleman, or rather, keep his profits to myself—making one thing fit in with another all round, as in these times I cannot afford to leave my corner to be filled up by some one else."

Mr. Garrett Taylor, of Norwich, gives the following account of the system of rearing pure Red Polled calves pursued on Whittingham farm, where the milk is produced for sale. As soon as born, the calves are put into separate cribs, and during the first week they have a daily allowance of about six pints of skim-milk, and after that time a small quantity of calf-meal, mixed in skim-milk if there is any to spare, and if not in lukewarm water. When the calves begin to eat, equal parts of linseed-cake (ground), malt, Barber's feeding-meal or any condiment meal, mixed with a little cut hay, are given to them daily, and they are kept on this until they are strong enough to take care of themselves, when they are drafted (five or six together) into a large box, and fed upon roots or grass, according to the time of the year, along with a small quantity of condiment feeding-meal, until they are about four months old, when they are again drafted into larger boxes (this time ten or twelve together), and the diet again altered to a small quantity of sweet silage, some roots or grass, according to the season, and 2 lb. per head per day of condiment feeding-meal. They are kept on this diet till they are twelve months old, and then turned out to grass, it being very seldom that any cattle on the farm are turned out to the pastures before they have reached that age.

Mr. R. Rowell, Middle Branton, Newcastle, after trying many methods, has fallen back upon one which he has found to answer best, and by which, with the milk of four cows, he can rear successfully no

fewer than thirty calves. One distinctive feature of his system is to feed from an early stage with dry instead of liquid food. By this method he very rarely has a case of scour, or looseness, and he has scarcely ever incurred any loss. The calves are at once removed from the cow on being dropped, and for the first fortnight they get, three times a-day, two quarts of new milk with a little water added. Thereafter they are gradually changed to a diet of skim-milk and ground linseed-meal. One half-pint of the meal is scalded, and added to a quart of skim-milk. This mixture is given to each calf until it is two months old, when liquid food is entirely discontinued, the calves having learned to feed by this time, and to do well on other food. In addition to nice sweet hay and turnips, cut with a sheep-cutter, they have as much as they will eat of the following mixture—viz., 2 parts each of bran and bruised oats, and 1 part of linseed-meal. Sometimes a little pure linseed-cake is given by way of variety. A constant supply of pure water is kept in their boxes. Mr. Rowell houses his calves in loose boxes, wherein there is room for from six to ten calves, with ample space for exercise. He finds the newly dropped ones do best along with those that are older, because the latter teach the younger ones to eat at an early stage. It is preferred to have the calves dropped before April if practicable, and they are turned out to grass by the middle of June, but the youngest ones are always taken under cover during the night.

Mr. Henry Ruck, of Eisey, Wiltshire, adopts a plan by which he uses little or no milk after the first fortnight. He thus describes it: "Seven lb. of finely-ground linseed-cake is dissolved in 2 gallons of hot water, and to this is added 2 gallons of hay tea; 7 lb. of mixed meal, consisting of equal parts of wheat, barley, oat, and bean meal, is also added, with 2 gallons of water. This mixture—which may be described as 7 lb. of linseed-cake ground fine, 7 lb. of mixed meal, 2 gallons of hay tea, 4 gallons of hot water—is given to the calves as follows: 2 quarts in the morning, further diluted with 2 quarts of water, and 2 quarts mixed with 2 quarts of water at night. Upon this gruel the calves thrive well, and they are weaned from it at twelve weeks old—having cost not more than from 1s. 3d. to 1s. 6d. per head per week."

Mr. A. Ralston, Glamis House, reports the system pursued by the most successful calf-rearers in Forfarshire to be as follows: The calves for the first week or so receive three feeds of milk per day, the morning feed being of new milk, and the other two feeds of skim-milk, the quantity given being about 6 gills per feed. As the calf grows older the quantity is gradually increased. When about three weeks old, or slightly before that age, the sweet milk is given up and the skim-milk increased to about 9 gills per feed. A substitute for the fat in the new milk is provided in the form of a mixture of ground linseed-meal, oatmeal, and locust-bean meal in equal proportions; the total weight of the mixture to begin with not exceeding .1 lb. per calf per day. This is increased as the calf grows older to about 1½ lb. The mixture is either boiled or scalded with boiling water until it assumes the consistency of thick gruel. It is then poured among the skim-milk

and given to the calves at every feed. When about six weeks old the calves receive along with the milk and gruel (now increased to about 12 gills per feed) from  $\frac{1}{2}$  lb. to  $\frac{3}{4}$  lb. of linseed-cake per day, along with a few handfuls of sliced turnips, and this treatment is continued with a gradual increase in both liquid and solid food until the age of three and a half to four months is reached—when the liquid, which by this time has been increased to about 16 gills per feed, is entirely stopped, and the calf, like the older cattle, has to depend entirely on solids. Mr. Ralston also records the successful practice of an enterprising dairy farmer who, while following in its general features the plan above sketched, separates the cream from his milk by mechanical means, and gives the skim-milk thus obtained to the calves in the warm state as it comes from the cow. He attributes much of his success as a calf-rearer to this feature of his practice, which corroborates the experience of Mr. Gilbert Murray, of Elvaston, Derby, in two particulars—viz., the value of fresh sweet separated milk, and the great importance of giving it at a proper temperature.

Mr. W. H. Ralston, Culmore, Stranraer, Wigtonshire, has successfully adopted the following method of rearing cross-bred calves out of his Ayrshire cows, which are kept either for the sale of milk or for cheese-making, according to the state of the market. For the first fortnight as much new milk as the calf can safely take is given. Then skim-milk is substituted for a portion of the new milk, with a little boiled oatmeal added. Thereafter only skim-milk is allowed, with a mixture of two parts oatmeal and one part linseed-meal, steamed together. By this time the calf will eat a little hay, and, so soon as it can be got to take it, a small quantity of finely ground linseed-cake is given. This diet is continued until it is considered safe to substitute, in place of a portion of the skim-milk, fresh-drawn whey. The one gradually takes the place of the other, until whey is the only liquid food given. One season, when the new milk was sold to the Dunragit Creamery, and when consequently no whey was available, butter-milk was bought from the Creamery at 2*d.* per gallon, and Mr. Ralston thought it made better calves than anything else he ever tried. Indeed, although unfortunately we have no definite detailed experience of individual calf-rearers who use butter-milk, yet it may safely enough be asserted that on this material calves thrive admirably, and grow into well-developed excellent cattle.

A gentleman who rears calves extensively in Ireland—viz., Mr. George Henry, of Ennismore, Listowel, County Kerry—gives an account of his system, according to which, it may be added, he reared, in 1889, no fewer than 200 calves, all of his own breeding. For four days the calf gets its mother's milk, for the reason that it acts medicinally upon the young animal. For the first fortnight it is fed three times daily on milk from which a little cream has been taken. In abstracting the cream Mr. Henry does not use the separator, but the Jersey creamer, which, after a thorough trial, he strongly recommends for this purpose. From the time they are three weeks old, the calves get a supplement of boiled linseed mixed with the meal and

other food—such as ground wheat and barley-meal which has been grown on the farm. By-and-by nice sweet hay is put in their racks, and they are also supplied with grated turnips with bean-meal shaken over them. The beans are ground, and only the fine meal given to the calves, the coarser portions being mixed with crushed oats for the horses. Mr. Henry remarks that, where large herds of one or two hundred cows are kept, the separators are in his opinion absolutely necessary; but in the case of small farmers having from ten to thirty cows, he advocates the use of the Jersey creamer in well-constructed, properly ventilated dairies. The cream should be sent to butter factories three times a week, whereby a large saving is effected as compared with sending the whole milk twice a day. Further, under this system, the skim-milk is retained at home for the feeding of calves and pigs. When potatoes were plentiful and cheap, Mr. Henry added boiled potatoes (without the skins) to the food of the calves after the latter were from two to three months old, with most successful results.

Mr. Luke Christy, Carigreen, Limerick, allows calves to remain with their dams for the first three or four days; then the diet consists of new milk for the next ten days or fortnight, thereafter skim-milk being gradually substituted. The supplement used is porridge made of wheat-flour and flax-seed, enough of the mixture being added to afford a full drink to each calf.

We will conclude by quoting some excellent observations which Mr. Gilbert Murray contributed to Mr. Gillespie's paper on "Calf-rearing." He wrote:—

"The housing of the calves is of equal importance with that of the food. On some farms they are relegated to the worst building on the farm, dark, undrained, and ill-ventilated. The litter is literally soaked with urine, and the fermented droppings emit a noisome smell. Diarrhœa of a virulent type sets in, invariably proving fatal to the more delicate subjects. Peat-moss litter when used is an immense improvement on straw, as the moss absorbs the urine, retards decomposition, and keeps the calf-house in a sweet and healthy state. The droppings should be daily removed, and a slight sprinkling of moss added.

"The calf-house should be specially constructed for the purpose. No expensive structure is needed, the chief merit being in the design. We are frequently putting up at a small cost wooden structures which fully meet the requirement. The walls are of wood. Oak or pitch-pine posts, eight inches square, are placed at intervals of about nine feet apart. These are covered with one-inch match-boards. The building is six feet six inches high to the under side of the wall plate, and eighteen feet wide. The rafters are covered with half-inch match-boards, on which is laid a covering of roofing-felt, at a cost of 1d. per square yard. The roof must have a coating of coal-tar and pitch yearly. We have roofs of this description in perfect order after a period of twenty years' wear. The buildings are well lighted and ventilated, and are divided into pens of eight feet by fifteen feet. A three-foot passage runs the whole length of the shed, parallel to which is the



manger for holding the food. This can be cleaned out, and the animals fed, from the passage. Each pen has a separate door, in order that the calves may be shut up at night or during the day in cold weather. A large open yard is provided in front of the shed, into which the animals are allowed access for exercise in the open air. This tends to increase their growth, while it maintains their health.

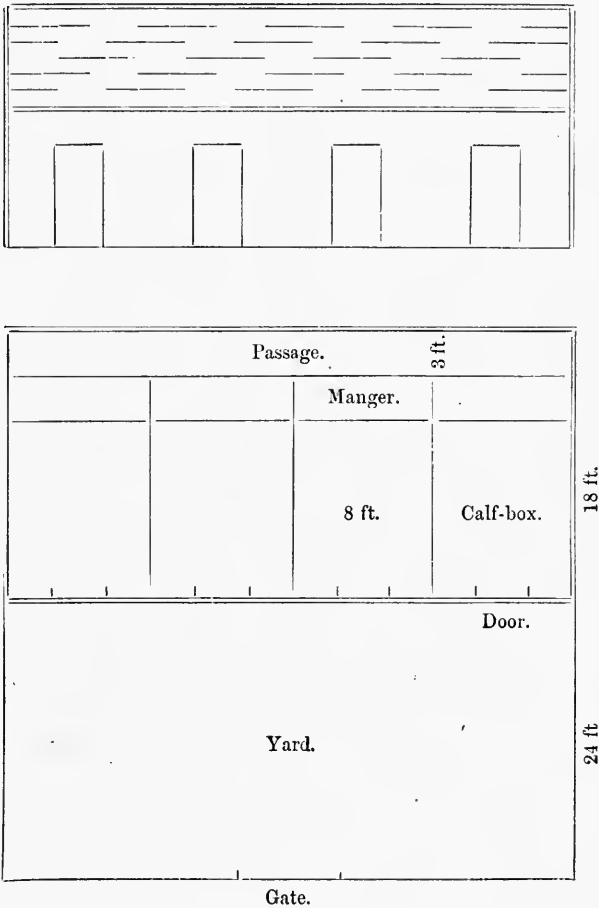


Fig. 44.—Plan of Calf-House.

Accommodation of this kind, though it may be rude and inexpensive, affords all the advantages of a more costly structure. Where the accommodation is suitable, the calves should not be turned out until they are a year old. Husk and many other disorders are brought on through exposure during the autumn of the first year of their lives. The best time for rearing calves under the old system is between the

1st of November and the end of January. Under the system we advocate, calves may be successfully reared throughout the whole year. Under it also the mortality would be considerably lessened, and the stock of the country soon be raised to its normal state."

Fig. 44, on the preceding page, is a sketch-plan of the calf-house which Mr. Murray describes.

In 1889, the "Live Stock Journal" collected a series of reports on the rearing of calves, particularly with respect to pedigree herds, in which the main object is of course to have good calves, either for sale as bulls or to add to the breeding herd. From these we select the two following:—

The late Mr. H. J. Sheldon, of Brailes, whose herd of Shorthorns greatly distinguished itself, said:—"My Shorthorn calves all suck their dams, lying with them for the first fortnight or so, and then being brought to them twice a day. When able to eat they have hay, and later some pulped roots, bran, oilcake, &c. The female calves go out to grass in the summer succeeding their birth. The bull-calves, of course, must be kept in boxes and yards, and have plenty of roots and green food as well as hay and some cake. Their thriving depends more on the attention and care of the feeder than on anything else. He should watch the state of their bowels, and feed accordingly. Many calves are spoilt by having too much nitrogenous food, which gets them into a feverish state. It is utterly impossible for any one to specify exact quantities of food that would be suitable to every calf, as these must be regulated by their strength, their appetite, and their powers of digestion, all which require to be watched and suited."

In Mr. George Simpson's well-known herd of Jerseys at Wray Park, Reigate, Surrey, the treatment is as follows:—The calves when first born are sprinkled with salt, so that the cow may be induced to lick them dry. They are taken from the cow about the third day, and have little cloths of rough flannel tied on them,—this of course only in the winter, and the trifling expense and trouble are well repaid by the greatly reduced tendency to scour. They are given three quarts of new milk during the day in three meals, the milk being mixed with equal parts of hot water, so as to bring it up to blood heat. At six weeks old they are gradually shifted on to skim-milk, still mixing with warm water. By the time they are eight to ten weeks old they are on four quarts of skim-milk, and now small quantities of ground linseed cake and coarse bran are given them, and a little sweet hay. The milk and water is gradually weakened and the cake, &c., increased till the calves are eating solid food and are drinking water. When out at grass they want nothing more after they are four to five months old till they are twelve months, unless they are weakly or the weather is bad. Some calves will drink too much at a time, and get out of shape in consequence; this must be guarded against. Again, some calves have a tendency to suck others; they should be watched, and if they do so, try wiping their mouths dry after drinking milk; if they still do it, separate them. Of course all these remarks apply to average calves; sickly small ones want extra or different feeding, and much care. Above all, keep the calf sheds clean,

this precaution being most necessary with milk-fed animals. A little Sanitas powder strewn about is a great deodorizer.

“As regards stock-rearing, the mechanical separator is,” says Mr. Gilbert Murray,<sup>1</sup> “the great invention of the age. The new milk is passed through the separator immediately it is drawn from the cow. With the exception of the butter-fat, nearly the whole of the original solids remain in the milk. Fats of an equally efficient and less costly character can be substituted, and may consist of linseed-meal and several crude oils of a cheap character. As the young animal increases in strength, a mixture of wheat, oat, and pea meal may be used with the milk. The success of rearing depends to a great extent on the care bestowed on the young animals: their food must be supplied at regular intervals, and, what is of the utmost importance, the milk must be fed at an uniform temperature—eighty degrees is the best. During separation the temperature will fall considerably; it must then be raised to the normal point—not in a vessel placed over the fire, which destroys the flavour, and to some extent alters the nutritive quality of the milk, but either by putting the separated milk into tins, and immersing them in boiling water, or, what is preferable, using a jet of steam. All the pails and vessels used for handling the separated milk should be kept scrupulously clean and sweet. The varying temperatures at which the milk is often fed, and the development of acidity caused by the use of dirty vessels, are the primary causes of scour and other irregularities of the digestive organs, inducing a mortality which frequently reaches twenty-five per cent.

“Neither stock-raising nor dairying can be separately carried on to the most profitable advantage—there must be a combination of the two industries; and this, again, involves a complete change in the general system of management, so far as regards the produce of the dairy. As soon as drawn from the cow, the milk must be passed through a separator, the chief difficulty on many farms being a suitable motive power. For small dairies, hand or horse power meets the requirements; the forty-cow dairies and upwards need something more powerful. In hilly districts, where water is available, a small turbine is not only the cheapest but the most satisfactory. On large occupations, where steam is generally used, the chief difficulty is that of cost. Having provided for this, there is yet another step—the factory; this should be centrally situated and generally accessible. The cream is delivered daily from the farm, to the factory, where it is made into butter; or, during the summer months, a part may be sold as fresh cream. On a moderate computation, an average cow will produce 220lb. of butter during the twelve months, which, at 1s. per lb., is 11*l.*; by an additional outlay of 5*l.* per cow on home-grown corn and oily seeds, in part to supply the butter-fat abstracted from the milk, a calf can be reared, which in ordinary times will be worth 10*l.* when a year old (with present [1890] high prices many have been sold for 50 per cent. more). A single calf would not consume the whole of the

<sup>1</sup> “The Best Means of Increasing the Home production of Beef.” *Journal of the Royal Agricultural Society*, vol. i. 3rd series, 1890.

separated milk, and there would be a surplus sufficient to produce 200 lb. of pork, at 6*d.* per lb. Having deducted the cost of the home-grown foods consumed by the calf and pigs, the gross return per cow is 20*l.*; from this must be deducted the value of the meal and other home-grown foods fed to the cow."

For incorporating with skim-milk, or with separated milk, a cheaper oil to replace the butter-fat which has been removed, an apparatus called the Lactoleofract, made by Mr. George Lawrence, Latimer Road, London, W., is sometimes employed. It is shown in fig. 45, where A is a steam-boiler; B, a lamp; C, steam outlet; D, emulsifier; E, milk-vessel; F, oil or fat vessel; G, G, screw plugs. The skim-milk and fat meet in the emulsifier D, and there, under the influence

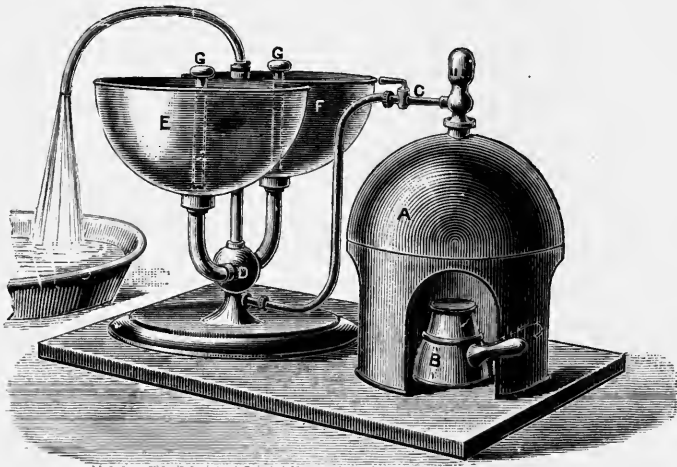


Fig. 45.—The Lactoleofract.

of a jet of steam, thorough emulsification is effected. For the purpose of calf-feeding the resulting product is as useful as new milk, whilst it is less costly.

The "North British Agriculturist," in referring to the plan of using separated-milk instead of skim-milk, and replacing the fatty matter extracted in the cream with linseed meal, or some other cheap substitute, says: "Separated-milk has many advantages over skim-milk. When the cream has been raised in an open vessel in the old and still general way, the skim milk is always more or less decomposed before the cream has all risen to the top, and the natural heat is all out of the milk. On the other hand, the milk may be run through the separator immediately after being drawn from the cow's udder, and if fed directly to the calves, its feeding value is much higher than that of skim-milk, because it still retains its natural heat, and no decomposition has had time to be set up in it. In Canada many of the farmers have separators, and send their cream direct to the butter factories, while retaining the separated milk for the rearing of calves and even the

feeding of bullocks. The plan of using separated milk along with linseed meal, or such other substitute for the cream, is also proving a prominent success in this country. Mr. James Somervell, in his dairy at Sorn, Ayrshire, rears a large lot of calves every year on separated-milk and oatmeal porridge—the calves getting full milk for the first fortnight, and separated milk, with porridge, thereafter. The Fairfield Farming Company at Kippen, in Stirlingshire, also rear all the calves dropped by their best milking cows. The plan adopted by this Company is to give the calves full milk for the first fortnight, and after that to give separated-milk, to which a little linseed meal has been added. Hand separators of the greatest efficiency can now be had at very reasonable prices, and this plan of economically rearing stock will doubtless be more extensively adopted."

The best time for castrating male, or spaying female calves, is about the expiration of the first month, as at that period there is least danger, provided they are in good health. This operation is, in some places, deferred until the animals are two or even three years old, but to the certain injury of their form, their size, the quality of the meat, and their docility at labour. Formerly castration was effected by tying a strong cord round the bag above the testicles. The nutriment of these parts being thus cut off, they were either suffered to remain until they dropped spontaneously, or were cut away, and the animal was perfectly castrated. Modern ingenuity, however, has devised a better means of removing the testicles, viz., by excision; but, as this cannot be effected without resorting to an experienced practitioner, we decline to give any directions respecting an operation which, if unskillfully performed, must prove greatly injurious to the animal. Let it, therefore, suffice to state, that after the calves are castrated, or spayed, as the difference of sex may require, the animals should be kept quiet, and tolerably warm for the first two or three days, and not be too highly fed.

Mr. Gilbert Murray advocated ("Journal of the Royal Agricultural Society," 1890) the spaying of all heifers not required for breeding purposes. He adds: "I believe the operation is neither difficult to perform nor attended with much danger, whilst it is obvious that the quality of the beef must be better. It is unnecessary to point out to those who are practically acquainted with the management of cattle the check to the progress of the animal through the periodic recurrence of natural causes. With the exception of those retained for breeding purposes, all the young stock would go to the butcher at a little over two years of age; the best time to bring them out is between the first of April and the end of June. If the bulls have been selected with judgment, each generation would improve for a long series of years."

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## CHAPTER VII.

## ON THE FEEDING OF CALVES, FOR VEAL.

VEAL being a favourite article of diet, the fattening of calves is an object of no small importance, particularly in the vicinity of large towns. Hence various kinds of food and modes of treatment have been recommended; but the best way is to keep the calves in somewhat dark places, in pens, lest they should fatigue themselves by sporting too much in the light, and to feed them on milk, with the addition of bean, pea, or barley meal, during the last few weeks. The calves usually become sufficiently fat in six or eight weeks; and it is not desirable to keep them beyond the time when they are fit for the butcher, as small veal, if equally fat, is preferred to that which is large. Cleanliness, as an indispensable object in fattening calves, should be particularly attended to here. For this purpose, the pens should be elevated to such a height from the ground that the urine may pass freely, and litter should be supplied every day, in order that the animals may lie dry and clean. A large chalk-stone may also be suspended over the pen, so that the calves may readily lick it.<sup>1</sup>

The following is the mode of rearing these animals in the vicinity of Abbey-Holme, in the county of Cumberland, where the calves are remarkable for their size, fatness, and pleasing white colour. During the first two or three weeks the young calves are fed in the common way; and, at the end of that time, are conducted to what are termed feeding-sheds. Two small stakes are driven into the ground for every calf, at the distance of ten inches or a foot from each other. The head of the animal is then put through the intermediate space, a strap or cord being passed round its head, on either side of which there is a ring that surrounds the stake. By means of this contrivance the calf is prevented from licking itself, which habit, it is supposed, would materially affect its health and growth, while it is not so confined as to be hindered from lying down or rising at pleasure. When the calf is somewhat reconciled to its new habitation, the Abbey-Holme farmers supply it with better food than it has been accustomed to receive. Rightly judging that the latter part of a cow's milk is more nourishing and of a richer quality than that which is first drawn, they divide the milk according to the respective ages of the animals, invariably giving the better part to the oldest calves.

Another circumstance peculiar to that district is the regulation of the temperature of the feeding-sheds according to the alternation of the different seasons, so as to keep them, as nearly as possible, at the same degree of heat. This practice cannot be too strongly recommended.

<sup>1</sup> Chalk is commonly supposed to assist in whitening the flesh. This idea is probably erroneous; but it has a salutary effect in correcting that acidity of the stomach to which calves are very liable, and in thus preventing the consequent scouring.

Warmth is, indeed, well known to be essential to the health, and particularly to the improvement in flesh, of all animals; but sufficient attention is not generally paid to the maintenance of an uniform temperature, although, next to a proper shelter, it is the point of greatest importance.

Cleanliness is also an object of rigorous attention, the place being kept constantly dry, and supplied with a proper quantity of good litter. As soon as any of the animals refuse regularly to take their food they are consigned to the butcher, and their place is occupied by the next in age.

Some of the Strathaven feeders give the milk at first sparingly, from an idea that it sharpens the appetite of the calves; but others, more naturally, and with as good effect, allow a full supply from first to last. During a week or two after they are calved they are not found to consume more than about half of a good cow's milk, but the quantity is gradually increased to as much as they will drink. A well-grown calf, at four weeks old, will consume the entire milk of one cow. If in good health it will, in two or three additional weeks, take the greater part of the milk of two cows; and, in order to bring them to the greatest degree of fatness, it is common to give those calves that are furthest advanced the last drawn or richest part of the milk of three cows, after they are nearly or quite two months old. This last practice, however, is rarely necessary; for it will generally be found that the animals will be fit for the butcher in about six or seven weeks, without any other attention than that of giving them their share of genuine milk, keeping plenty of clean litter under them in a place that is well aired and of moderate warmth, and excluding the light. Some have given eggs, and others have put meal into the milk; but the best feeders do not approve of such admixtures, which, they say, darken the flesh of the animal.<sup>1</sup>

The instructive writer from whom we have extracted this account does not state the average quantity of milk consumed by the calves during the process of fattening; but he says that the Strathaven farmers calculate on realising ten shillings per week from each calf, valuing the milk at from  $1\frac{3}{4}d.$  to  $2d.$  per quart; and many have used their milk in feeding veal when they could have sold it at these prices. If this is the case, it is clear that either the system or the stock must be superior to anything of the kind in England; for the calculation of the profit of suckling in Essex, where it is usually practised for the London market, is only four shillings and sixpence per week. Although that may be under the mark, yet ten shillings would probably be as much above it.

We are informed that the calves in Holland are reared in long and narrow, but tolerably lofty, suckling houses. The pen in which the calf is kept is so narrow that it cannot turn round, but only go backward to the end of the pen, which is very short, or forward to the door. The house is kept in total darkness, and the pen is perfectly clean and sweet. When the suckler comes to feed the animal, a small hole is opened in the doorway sufficiently large to admit the head of

<sup>1</sup> Aiton's "Dairy Husbandry," chap. iii., sect. i., p. 60.

the calf. As soon as the animal perceives the light it advances towards it, and thrusts out its head, which the suckler puts into the pail. Being taught thus to drink the milk, it very soon gets fat, and much more quickly so than by either of our modes, in which the calf is usually tied up, or is permitted to run about in an open place. The Dutch farmers hang up a piece of chalk near the door for the animal to lick; and the pen is so contrived as to height that, when the calf is about to be removed, and the door of the suckling-house is open, it falls down on the tail of the cart, and the animal walks in and is secured. The floor of the Dutch calf-pens is a lattice-work, so that it is always dry.<sup>1</sup>

The practice is admirably adapted for fattening calves for the butcher, for which quietude is absolutely requisite; but where the object in rearing them is to keep them as stock, it probably will be found more conducive to their health to turn them into a sheltered paddock or yard, only housing them at night.

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## CHAPTER VIII.

### OF STEERS AND DRAUGHT OXEN.

THE following description of the "points" of an ox is both interesting and instructive:—

"The head should be fine and tapering to the muzzle, which should be thin. The neck should be free from coarseness, large where attached to the shoulder, and tapering to where it joins the head. The breast should be wide, and projecting well in front of the fore-limbs. The shoulder should be broad, but joining without abruptness to the neck before and the chine behind. The back and loins should be straight, wide, and flat; the girth behind the shoulders should be large, the ribs well arched, and the distance between the last rib and the hook-bone small. The hook-bones should be far apart, and nearly on a level with the backbone from the hook-bone to the rump; the quarters should be long and straight; the belly should not hang down; the flank should be well filled up; the legs should be fleshy to the knee and hock, but below the joints they should be tendinous. The tail should be on a level with the back; broad at the top, and tapering to near the extremity. The hoofs should be small; the horns fine and pointed, and slightly attached to the head; the ears thin; the eyes prominent and lively."<sup>2</sup>

The use of oxen for the purpose of draught is now nearly given up in this country. Occasionally, in the Scotch Highlands, a small crofter may be seen ploughing with a cow yoked alongside a Sheltie, or

<sup>1</sup> "Malcolm's Compendium of Modern Husbandry," vol. i. p. 354.

<sup>2</sup> "Low's Practical Agriculture."



small Highland horse, but farmers generally have abandoned the use of draught oxen. It might therefore have been advisable to have left out in the present edition the following remarks; but as this work circulates largely amongst colonists, with whom the labour of oxen is often a matter of necessity, it has been deemed advisable to retain them.

A good ox for the plough should be neither too fat nor too lean, for in the former case he will be lazy, and in the latter he will be weak and unfit for labour. His body should be well developed, joints short, legs strong, eyes full, coat smooth and fine, and every part of the body well put together, so that his strength may easily be exerted.

Another requisite is that he should answer to the goad, and be obedient to the voice. To this he can only be brought by gradual habit and gentle treatment. The calves that are designed for the yoke should not be broken in earlier than at two and a half or three years, lest they should be overstrained; <sup>1</sup> nor should this be deferred longer, because they may afterwards become stubborn and ferocious. Their work should be so proportioned as not to affect their growth, which continues until about their seventh year. Where this is not attended to, their value may be lessened in a greater degree than will be compensated by their labour.

The strength of this animal, when properly trained and managed, is very great, and he has patience to endure fatigue; but, being naturally slow, he must not be hurried beyond his usual pace. The only method by which success can be attained includes patience, mildness, and even caresses: compulsion and ill-treatment will irritate and disgust him. Hence great assistance will be derived from gently stroking the animal along the back and patting him, and encouraging him with the voice, and occasionally feeding him with such aliments as are most grateful to his palate. When he has thus become familiar, his horns should be frequently tied, and, after a few days, a yoke put upon his neck. After this he should be fastened to a plough with an old tame ox of equal size, and employed in some light work, which he may be suffered to perform easily and slowly. The young steer will thus be gradually inured to labour. After working in this manner for a certain period, the steer should be yoked with an ox of greater spirit and agility, in order that he may learn to quicken his pace; and, by thus frequently changing his companions, as occasion may allow, he will, in the course of a month or six weeks, be capable of drawing with the best of the stock.

After the steers are thus properly trained, it will be advisable to match such as are intended to draw in the same team or yoke, attention being paid to their size, strength, spirit, and temper; otherwise, by being unequally matched, they will not only spoil their work, and be greatly disqualified for draught, but the slower or weaker animal of the two, being urged beyond its natural powers, will inevitably receive material injury.

Another circumstance of essential importance in breaking-in young

<sup>1</sup> In Devonshire, however, they are frequently put to gentle work at two years of age.

oxen is that, when first put to work, whether at the plough or in teams for draught, they should not be fatigued or over-heated. Until they are thoroughly trained, therefore, it will be advisable to employ them in labour only at short intervals, to indulge them with rest during the noon-day heats of summer, and to feed them with good hay, which, in the present case, will be preferable to grass. In fact, while oxen are worked, they must be kept in good condition and spirit.

On their return from labour it will greatly contribute to the preservation of health if their feet are well washed previously to leading them into their stalls, otherwise diseases may be generated by the filth adhering to them, while their hoofs, becoming soft and tender, will necessarily disable them from working on a hard or stony soil. The extremes of heat and cold ought also to be carefully guarded against, as disorders not unfrequently arise from either excess, and oxen are peculiarly susceptible to fevers and to the flux, if chased or hurried, especially in hot weather.

The following mode of training and working oxen, which has been successfully adopted in North Britain, we give in the words of the farmer by whom it was practised :—

“ Out of my stock of cattle,” says he, “ I select, when two years old (that is, after harvest, when they are rising three), four of my stoutest, best-shaped *stots* from the field. These, to accustom with harness, I bind up in my oxen byre every night for a week or two ; and they are then taken out in pairs, and put into the plough with a pair of older-trained oxen yoked before them. This keeps them steady, and prevents their running off. After being yoked in this manner two or three times, I turn them again amongst the cattle in the straw-yard, where they remain until spring. They are then three years old. I yoke them all four, after training them as above stated, in a plough by themselves, which requires a little boy to drive ; and in that way they are used until four years old, when they are worked in pairs as horses, by one man only, and do the same work at ploughing ; for at carting, &c., I never use them, having as many horses as do that part of my work. When used in pairs, one man works two yokings, and the cattle only one each. If, however, I had occasion for two cattle-ploughs, each pair might work well two yokings, the same as horses.”

The same correspondent also remarks : “ If, when three years old, eight *stots* were worked four and four *alternately*, it would be a great relief ; and I have uniformly found that cattle *moderately worked* thrive better than those that are idle or unemployed.”<sup>1</sup>

The following system of a succession of breeding and working cattle was recommended by that eminent agriculturist Mr. Ellman, of Glynde, in Sussex—the numbers depending on the means or inclination of the breeder :—

14 calves ; of which nine were males : eight were kept for oxen, and one allowed for accident, or not taking to work.

14 two-year olds ; of which eight are worked a little at two years and a-half.

<sup>1</sup> “ Farmer’s Magazine,” vol. iii. p. 450.

14 three-year olds; part of which were taken for cows, and others, if not good, fattened.

14 four-year olds; eight worked.

14 five-year olds; do.

14 six-year olds; fattened.

Thus twenty-four oxen are worked—eight at three, eight at four, and eight at five years old; and a reserve is kept for breeding cows, and accidents.<sup>1</sup>

The details of the Earl of Egremont's system, as followed to a great extent at Petworth, were as follows:—

The calves are dropped from December to the end of February. They are weaned immediately, never being permitted to suck, but the milk being given for a few days, as it comes from the cow. When weaning on skim-milk, they should fall in December, or a month before or after, and should then be kept warm by housing; thus they will be equally forward with calves dropped late in the spring, and that run with the cow. With the skim-milk some oat-meal is given, but not until the animal is two months old, and then only because the number of calves is too great for the quantity of milk. Water and oatmeal are then mixed with it, to make it go farther. To this heifers with their first calves are exceptions, for they do not become good milkers if their calves are not allowed to suck for the whole season (?). With the second calf they are treated like the rest. In May, the calves are turned to grass. During the first winter, from the beginning of November, they are fed upon *rouen*, or, as it is also called, *after-math*. In the following summer they are at grass; and in the second winter on straw, with a turn on short rough grass. They have been tried on hay alone, but straw and grass do better. During the following and every other summer they are on grass, and are broken-in at Christmas, being then three years old, but are only lightly worked until the spring, when their real labour begins. From this time their winter food is straw, with clover hay from the beginning of January. They are previously kept on straw alone, yet are worked three days in each week.

The best working breeds are the Hereford, Sussex, Devon, and a mixed breed between Hereford and Sussex. Some give the palm to Sussex cattle for working powers, but this is chiefly in their own county; beyond that they are little used.

Mr. Hall Keary states that Devon cattle are extensively used for the plough in Norfolk, and that for working purposes they are unrivalled. "There is almost as much difference," he says, "between a Devon ox and other breeds, as between a light, cleanly, active cart-horse, and a heavy, hairy-legged, sluggish dray-horse."<sup>2</sup>

The general character of the ox is patience and tractability. If young steers sometimes prove refractory and vicious, it is in most instances the result of defective management, or of bad treatment when first broken for the yoke. When an ox is unruly or stubborn, it will

<sup>1</sup> See "Agricultural Survey of Sussex," p. 261.

<sup>2</sup> "Journal of the Royal Agricultural Society," vol. ix. 1st series, p. 436.

be advisable to keep him until he is hungry; and, when he has fasted long enough, he should be made to feed out of the hand. On his return to labour he should be tied with a rope. If he at any time becomes refractory, gentle measures should always be attempted in order to bring him to work readily and quietly.

In *working oxen* to advantage, much depends on the mode of harnessing them, and the question as to whether it is most advantageous to yoke oxen by the head or the collar, has occasioned much discussion, and is even yet undetermined. The opinion throughout Great Britain is, almost universally, in favour of the collar; but throughout Spain and Portugal where oxen are the only animals employed in agricultural labour, whether of road or field, they are invariably yoked by the head. The strength of the animal lies in his neck, of the power of which the head-yoke affords him all the advantage, while the collar

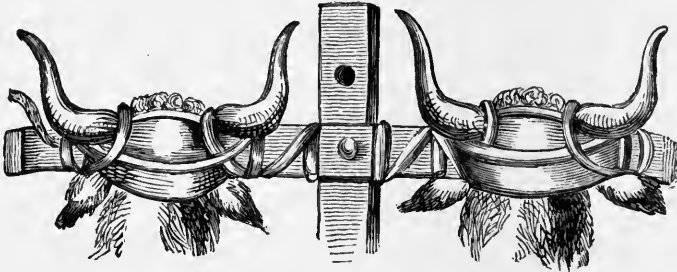


Fig. 46.—Yoke for Draught Oxen Used Abroad.

deprives him of it, as he does not draw by the shoulders. The greater cost and trouble of harness, of yokes and bows, are also considerations of importance. In summer, harness has been found an incumbrance, the ox requiring all the relief and liberty that can be afforded in hot weather.

In Portugal these animals are harnesssed in the following manner. A long leather strap is wrapped round the yoke, whence it passes to the lower part of the horns, and is again fastened to the yoke. By this contrivance the heads of the oxen become more steady while performing their work, and the animals are rendered more tractable. In France, and in the Peninsula, oxen are yoked in a manner better expressed by the aid of figures than by description. Fig. 46 represents a view of the hinder part of the head and neck of these animals in the yoke, as they appear to a spectator. Fig. 47 exhibits a front view of the upper part of their heads, in order to convey a more accurate idea of the mode in which the French oxen are fastened to the bow. We understand that the Earl of Shannon introduced this method of yoking oxen into Ireland, and that two oxen thus harnesssed were enabled with great ease to draw the enormous weight of three tons.

The advocates for the collar insist upon the advantages of single-ox carts; and of ploughing with the team at length, by which, as they walk in the furrow, the land is not so much poached as when they are

yoked abreast. They affirm, also, that the pace is quicker in harness, and that the animal works with greater ease. But their opponents allege that oxen are more advantageously worked in couples than singly, inasmuch as, being nearer to the draught, they possess greater power over it than when drawing at length. They also consider that the additional expense occasioned by a double number of one-ox carts and drivers more than counterbalances the advantage of their use even if

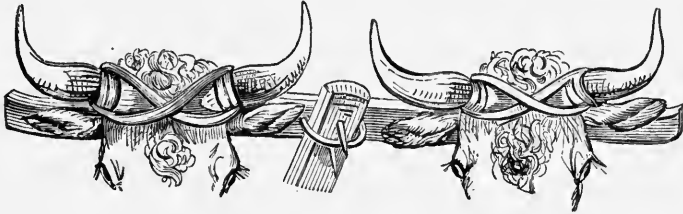


Fig. 47.—Improved Yoke.

anywhere admitted, and they deny that the animal works either quicker or with greater ease.

It would be an endless task to detail the various comparative trials that have been published on this long-contested subject; and it may be deemed sufficient to state the result of two, made some years ago in

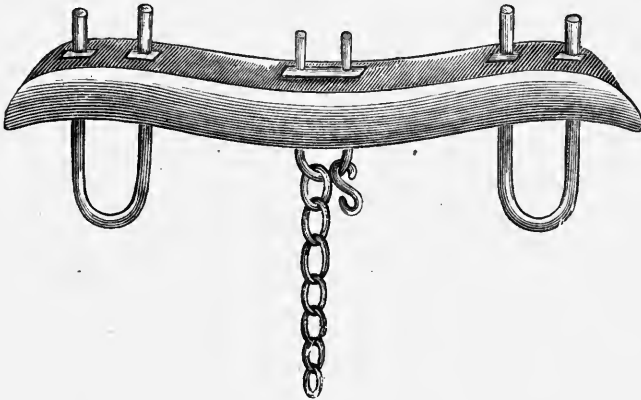


Fig. 48.—Sussex Yoke for Draught Oxen.

Sussex, where, from oxen being extensively used, the dispute had excited more than ordinary interest.

In order to decide the respective merits of the two methods, it was agreed that an acre of land should be ploughed by two teams, the one of six oxen in double yokes, the other of four oxen in collars; and then, again, with four oxen in single yokes, against four in collars. In the first trial, the six in yoke beat the four in collar easily; and in the second there was only three minutes difference. The

work was equally well performed; but the ploughing must have been very light, as the last match was completed in four hours and ten minutes.<sup>1</sup>

So far as this experiment may be considered decisive, it re-established the equality of the teams; but had it been tried with more severe labour, or on hilly ground, it might have proved different; and, in steep ascents more particularly, the yoke would probably have been found best adapted to the animal. It is a prevalent idea in England, that oxen are unfit for draught in hilly countries; a large portion of the Peninsula, however, is mountainous, and there they draw heavy weights in carts of a very rude construction. Being worked in yokes, they possess the power of preserving the line of draught, by lowering the head according to the inclination of the ground, an advantage which is lost in the application of the collar; and their chief strength is, also, supposed to depend on the joint power of the neck and the base of the horn.

The Earl of Egremont, also, put his cattle to the test at Petworth, in both road and field-labour, and his experience confirmed the opinion in favour of the old Sussex yoke, of which fig. 48 is an illustration.

Connected with the subject of draught is another, which has only received of late years the attention that it deserves—viz. the *shoeing of oxen*; a necessary operation that, when carefully executed, will not only conduce to the animal's comfort and health, but also to the farmer's profit; for he will be enabled to draw both with greater speed and superior effect. According to the old practice, the animal was first *cast*, or thrown, and his legs bound together in the usual manner; he was then forced nearly upon his back, and his feet hoisted up to a convenient height by means of a forked pole, the forked end taking the bandage that bound the feet, while the opposite end was firmly fixed in the sward upon which they were thrown. The farrier then proceeded to affix the shoes in a manner similar to that practised on horses. By this contrivance the shoes were easily and firmly applied, but it was attended with the disadvantage that accidents sometimes occurred in the operation of casting; the other oxen were also apt to become unruly on seeing their companions roughly treated, and many valuable cattle were rendered completely useless. To obviate such accidents, an ingenious appliance, of great simplicity, was adopted at Mr. Bakewell's farm at Dishley. It merely consisted of four posts, A, B, C, D, fig. 49, fixed firmly in the ground, and furnished with strong side-rails.

The animal having been led in, is confined by four straps going over the back and under the belly. The two projecting branches are hollowed on the top, for laying on the fore-legs one at a time; the hind-legs are severally held out, when wanted, by a long wooden lever, and thus the shoes are applied without any possibility of injuring the beast. It has, indeed, been suggested, and we think the plan might be easily carried into effect, that if calves intended to be reared for work were accustomed, while young, to have their feet taken up, and their hoofs

<sup>1</sup> See "Agricultural Survey of Sussex," p. 261.

beaten with a hammer, and this practice repeated during the winter while the steers are in the yards, they might afterwards be shod in the same manner as horses, and with equal facility.<sup>1</sup> It is well stated that little skill is required in the smith in order to adapt the shoe to the foot of the ox. There is no weakness of particular parts, no corn, no tenderness of frog, no disposition to contraction to be studied. The simple principle is to cover the sole effectually. Around the outer rim the shoe should follow the line of the foot; it should somewhat project inwardly towards the toe, and be rounded towards the heel with

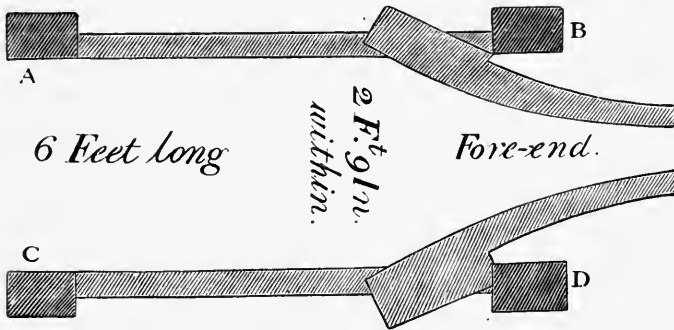


Fig. 49.—Bakewell's Shoeing Shed for Oxen.

the projection likewise inward. It should be fastened by three nails on the outer edge, the posterior nail being about the middle of that edge. The nails should be thin and flat-headed, so that when driven close they may occupy a considerable portion of the ground-surface of the fore part of the shoe. Both the ground and foot surfaces should be flat, and the shoes made of good iron, but thin and light. The only difference between the fore and the hind shoe is, that the hinder shoe is thinner and lighter, not quite so broad or so much curved, and particularly more pointed and turned up at the toe.

Some farmers shoe the fore-feet only, others take in the two outside claws of the hind-feet. A little additional trouble or expense being taken, they would be safer.

<sup>1</sup> On the Working and Shoeing of Cattle, see chap. viii. No. 5, on "British Husbandry," in the Farmer's Series of the Library of Useful Knowledge.

## CHAPTER IX.

## OF GRAZING CATTLE.

THE feeding and fattening of cattle is an important object in the economy of the grass farm; hence the farmer should previously consider the *nature* and *fertility* of his *pastures*, and the extent and quality of his other resources; and according to these he should regulate his system of *grazing*, *soiling*, or *stall-feeding*. He should then select those animals only which evince the most *evident disposition to fatten with the least consumption of food*, and depasture them upon such lands as are best calculated for the respective breeds, especially taking care not to bring cattle from rich to inferior soils, but, wherever it is practicable, to choose them from lands of nearly the same quality as those destined for their reception.

The introductory view of the different breeds of cattle given in the early pages of this work will probably supply some hints for enabling the farmer to decide what kind of stock is adapted for special situations. In addition to this we would observe as a rule,—a very simple one, but of great practical importance,—that the larger beasts are preferable for the more luxuriant pastures, while in such as are less rich small stock answer best. Thus, a grazier who has fertile pasture or deep alluvial land may select his beasts as large as he can find them; but he who has only indifferent grass should take care to proportion the *size* of his beasts to the *quality* of their pasture, for it is better to have cattle rather too small than too large for the quality of the land.

Hence we find that, in the rich grazing counties of Durham and Lincoln, large breeds are chosen, while in Norfolk and Suffolk the Highland, Galloway, and other Scotch cattle as well as a large number of Irish are fattened in preference to other breeds, not on account of their value and the excellence of their flesh, but from their suitability to the lightness of the soil.

The Herefords, the Devons, and the Shorthorns are breeds now much approved for grazing and fattening purposes; and after them come the black Welsh, and the Red Polled breeds of cattle, all of which are eminently profitable in particular situations. In order to carry on the grazing of cattle with effect, it is necessary that the farmer lay down a definite plan or system, and proceed regularly therein, deviating from it in those instances only which obviously tend to improve his cattle, and thus ultimately to increase his profits.

With regard to the kind of cattle best calculated for profitable grazing, spayed heifers and oxen are sometimes looked upon as superior to any other stock. The former are of less frequent occurrence, but they fatten more quickly. Many graziers consider heifers more kindly in their disposition to feed than steers, particularly when they have



already had a calf; and Mr. Honeybourne, the successor of Bakewell, at Dishley, was of opinion that they are superior to oxen for fattening at any age, and will uniformly produce a greater weight of beef per acre.<sup>1</sup> Cows are, however, liable to diseases of the udder on some land. Wintering heifers in-calf, in some grazing districts termed *in-calvers*, may also be advantageously followed if attention is paid to selection, and the beasts are well fed during the winter on rich succulent crops. They are occasionally sold for small sums at the autumn or Michaelmas fairs, and may be disposed of in the succeeding spring, at considerable profit, with their calves running by their side.

*Free Martens*, or sterile cows (see page 119), have been tried for the purpose of fattening, but they rarely succeed. The same may be observed with regard to very old cows. In some few instances they may prove a source of profit, but the speculation is a hazardous one, and at best they are much inferior to young or middle-aged stock in point of *kindliness to fatten*. Such cows have been found to fatten more readily after they have taken the bull than when barren. Indeed, it is a common practice with graziers to run a bull with their fattening heifers and cows, because when bulled they are quieter and fatten more quickly.

In stocking lands, the proportion of beasts must depend upon the fertility of the soil, and it will generally be found that local custom will afford the surest guide. In the counties of Somerset and Devon one acre or one acre and a half of the better kind of land is allotted to one ox, to which a sheep is sometimes added. The best grazing land in Lincolnshire, we are told, will, under favourable circumstances, support an ox and a sheep per acre during the whole summer; and the former will gain 20 stones, or 280 lb., and the latter 10 lb. a quarter, or 40 lb.

In order to graze cattle to advantage, it is well to change them from one pasture to another, beginning with the inferior ones and gradually removing into the best. By this expedient, as cattle delight in variety, they will cull the choicest part of the grass; and by filling themselves quickly, as well as by lying down frequently, will rapidly advance towards a proper state of fatness, while the grass that is left may be fed off with store cattle, and lastly, with sheep. Hence it will be advisable to have several inclosures, well fenced and sheltered, and abundantly supplied with wholesome water. Respecting the best size for such inclosures, or divisions of land, there is a difference of opinion. The size of individual fields is not of much consequence, so far as the cattle are concerned. Too many fences, however, are costly and inconvenient, and of no benefit, save perhaps as shelter. It is an advantage to have all pastures well bared off once a year at least.

Before we proceed to discuss the other circumstances connected with the grazing of cattle, it will not be altogether irrelevant to state a few particulars concerning the peculiar practice or management of some of the most eminent graziers.

<sup>1</sup> See the "Agricultural Survey of Leicester," p. 232.

Some farmers purchase store cattle in the months of March, April, and May, and turn them upon the pastures as soon as there is enough grass. Then the beasts become completely fat on grass towards August or September, or later in the year, according to their kindliness in taking on fat. In the county of Middlesex this method is adopted with great success on the hay farms. The graziers there purchase small cattle, that are in tolerably good condition, as early in the autumnal quarter as the *rowen*, *latter-math*, or after-grass, is ready: into this the cattle are turned, and are sold to advantage about the end of October or the beginning of November.

There is another mode practised in some grazing districts, where the lean stock are purchased at various periods and of different sizes, so that, some becoming fat sooner than others, they may be sent to market in succession. According to the management of these people the cattle are sometimes kept throughout *two* winters, during the first of which they are not at *full keep*, but in the following summer they are turned into good grass, and fattened off in the second winter with the best and most forcing food that the farmer possesses. A common system, however, consists in buying small cattle as early in the spring as the grass affords a good bite, when they are allowed one summer's grass, and are stall-fattened in the ensuing winter.

A variety of circumstances will claim the farmer's attention in the grazing of his cattle, in order to conduct his business with regularity, or with profit. He should take especial care not to turn his stock into the pastures in the spring, before there is a *full bite*, or the grass has obtained a sufficient degree of length and maturity; for cattle, whose tongues chiefly enable them to collect the food, neither can nor will bite near the ground, unless they are compelled by hunger. In this case, it is obvious that they cannot feed with ease and enjoyment, and consequently cannot thrive as they ought to do.

Where beasts are turned into fields consisting either of clover entirely, or of a mixture of natural and artificial grasses, much circumspection is required, in order to ensure that they do not devour so eagerly, or to such excess, as to become *blown* or *hoven*,—a disorder to which cows are more peculiarly liable than the other neat cattle. This disorder, however, may be prevented either by feeding the animals so as to gratify the cravings of appetite before they are turned into the pasture, or by constantly moving them about the field for a few hours after they have been turned in, in order that the first portion, at least, may be partially digested before the next is consumed. The former plan is the better; the latter wastes the grass by trampling. Should they, notwithstanding this, be attacked by *hoven*, which arises from greedy eating, particularly when the dew is on the grass, they may be relieved by adopting the remedies pointed out in a future chapter (page 548).

Although the various grasses of which a pasture is composed ripen at different periods, yet the sward usually attains its greatest luxuriance about Midsummer; and from that time to Lammas it possesses a

peculiar sweetness, so that during the intervening period stock may be allowed to bite somewhat nearer to the ground. It will, however, be necessary to remove fattening cattle, from time to time, into fresh grounds; so that by taking the uppermost and choicest part of the grass, they may feed both expeditiously and profitably, and no loss be thus incurred; for, as before stated, the grass left behind them may be fed off, first with later cattle, and afterwards with sheep. This plan cannot be too carefully regarded, for if cattle are in want of sufficient food, they will lose more flesh in one day than they can possibly recover in three.

The pastures that are in fenny situations, or retain moisture for a considerable time, should be fed off as early as possible, lest sudden or long-continued rains should fall; these will not only render the juices of the grass thin and watery, and ultimately putrescent, but will also materially affect the health and constitution of the animal. In order to prevent the losses consequent on such a course, it will be necessary daily and attentively to inspect the grazing stock, and if any beasts appear to be affected by eating wet grass, they should be immediately withdrawn to a dry pasture, and fed with hay or straw; or, if they cannot be conveniently removed, they must be driven to the driest spot, and there supplied with *sweet cut grass* and *dry fodder*.

The *heavy* or *light stocking of pasture ground* is a point on which many graziers are by no means agreed. By some it is contended that the pastures should be stocked very lightly. They allege that although much of the produce is thus allowed to run to seed—produce which the cattle will not eat, and which is consequently trodden under foot, where it rots and is wasted,—yet experience shows that a greater profit will, on the whole, be derived thus than by any other practice.

By others, on the contrary, it is maintained that the practice of light stocking is highly to be condemned—because it not only tends gradually to diminish the produce, but also to encourage the growth of coarse and unprofitable grasses, which materially deteriorate the pastures—and that the *heavy stocking* of grass lands, particularly those of a rich quality, is an indispensable requisite of good management. It must be confessed that the superior fertility of the heavily stocked Lincolnshire pastures tends greatly to corroborate these views, which also receive further support from the practice of the most experienced graziers in Romney Marsh. It is recommended by yet others (whose opinion, perhaps, approximates more nearly to the truth), that *mixed stock* should be always kept on the same field; for the foul grass, produced by the dung of some animals, will be consumed by others; and, as different kinds of stock no doubt prefer different species of grasses, there is an evident advantage in this practice.

In every field numerous plants spring up spontaneously, some of which are disliked by one class of animals, while they are eaten by others; and not a few plants, although eaten with avidity at a particular period of their growth, are entirely rejected by the same beasts at another time. Hence it becomes necessary, not only to have a variety of stock in the same pasture, but also to pay particular atten-

tion in order to augment or diminish the proportions of some of these classes of animals at certain periods of the year, otherwise a part of the produce will run to waste.

On this it is, however, to be observed, that where a great variety of animals are allowed to go at large in the same pasture, they rarely feed with that quietness that is necessary to ensure their thriving. One class, or description of beasts, is inclined to feed or to play, while others are mostly at rest; and thus they mutually tease and disturb each other, and this inconvenience is materially augmented, if any kind of *penning*, or confinement, is attempted. Hence, also, it is obvious that the practice of intermixing various kinds of live stock is productive of evils that are, in many instances, greater than those resulting from the waste of food intended to be prevented. There is, indeed, no doubt that by *heavy stocking* the grass will be kept short, and will consequently be more palatable to the animals that feed on it than if it were allowed to grow to a considerable length; but as animals that are to be fattened must not only have *sweet* food, but also an abundant quantity, it seems scarcely possible to unite both these advantages with an indiscriminate mixture of stock; it may, therefore, be generally prudent to confine the practice to neat cattle and sheep.

Much depends on whether the farmer is able to eat down his pastures tolerably bare in late autumn or early winter by store stock. If he is, it is an advantage to have a lot of grass left on the pastures when the fat stock are sold off. If he is not, it is better, as the writer has good reason to know, to stock rather heavily with fattening cattle, and supplement the grass with cake. In this way, indeed, the pastures improve year after year, and will carry more cattle.

The following remarks by a "Practical Farmer," in the pages of the "Mark Lane Express," will be useful:—

"There is no department of a farmer's business that requires so much of his attention and matured judgment as the management of his stock. The anxieties of the winter are now over, and the adaptation of his stock to their pastures now claims his chief care. This is a question of no ordinary course. The state and condition of his stock, and the nature, fertility, and fruitfulness of his pastures, are alike equally requiring his notice. These must be in a state to suit each other. The condition of the stock to be depastured upon them must be in accordance with the 'strength' and richness of the pasture. To 'lay on' stock in poor or weak condition upon a rich or strong pasture, is certainly a very dangerous course, if not a destructive one. Good land must be stocked with good animals, or at least animals in a safe and healthy state. Poor or lean stock may thrive on rich soils, if not too abruptly put upon them, or on fast-growing fruitful pasturage, should a favourable season produce such on a poor soil.

"The art or science of grazing is no simple one, let the querulous and the despiser say what they may. The politician has the cares of government upon him; the banker, his issues, his notes, and his drafts; the merchant, his goods, his trade, and his credit; the manufacturer, his material, his orders, his patterns, his fabrics, and his workmen;

the trader, his stock, his customers, and his bills. These and others, many and many, have their own peculiar cares and perplexities; but none are greater in number or in proportionate importance than those cares, anxieties, and perplexities daily experienced by farmers and stock-owners. Every animal is an object of individual and of especial daily care, every crop and every kind of crop is an especial object of intense interest, as upon the success attending the one or the other the farmer thrives or fails.

“The profitable grazing of his stock, then, is to him a matter of paramount importance, and great are his anxieties as to the best mode of carrying out this department of his business. Much will depend upon the character of the soil and pasturage with which he has to do. The occupiers of land of the first class—lands qualified to fatten readily the finest oxen—have a plain course to pursue. Theirs it will be to depasture with cattle of a high order; to put cattle in high condition, and requiring no great length of time, on good pastures, to prepare them for the butcher, and to bring them quickly up to the first quality of meat. The next order of lands would be the prime sheep-pastures. These cannot be put to better purpose than in depasturing sheep of good age and condition, and the quantity of mutton and wool produced per acre goes well-nigh to exceed in profit the somewhat superior bullock-lands. Be that as it may, each variety of land is best to be kept to its order of grazing—‘bullocks’ to bullock lands, ‘sheep’ to sheep lands.

“The great difficulty that graziers have to contend with, is to make the most profit of the intermediate lands, and rotation seeds and clovers. Speaking generally, these had better be appropriated to breeding purposes, dairying, and the grazing of young stock. Most of the ‘sweet lands’ in the Midland and other counties are well adapted for dairying uses, and nothing can pay better where conveniences accord. The produce of the dairy and the rearing of the young cattle are doubly remunerative, though there are exceptions; the majority of common grazing lands are adapted for dairying; or if some of the most fertile of these second-class lands are appropriated to fattening uses, it should be in conjunction with artificial aids. Cattle and sheep on such lands will fatten satisfactorily if liberally supplied with linseed-cake—from four to six pounds for a bullock, and from half-a-pound to a pound for a sheep, depending much upon the size and weight respectively.”

Independently of remedying the inconveniences above specified, a variety of circumstances combine to prove that the practice of *soiling*, or feeding cattle during the summer with different green and succulent vegetables that are cut and carried to them in the sheds—and of box and *stall-feeding* them in the winter season with dry fodder, in conjunction with various nutritive roots—will in general prove most economical. The terms “soiling” and “stall-feeding” are in one sense synonymous, as in both of the systems the leading feature is the *housing* of the cattle. The term “house-feeding” is therefore used by some writers; but inasmuch as there is actually a distinction between the kind of food used

in the summer and winter feeding, we treat the two systems as distinct in character, denoting however the one as "summer soiling," the other as "winter box or stall-feeding." We proceed, therefore, to say a few words on both these important subjects.

Before doing so, however, we think that a brief notice of the principal points of a paper read by Mr. Owen Wallis before the Central Farmers' Club, on the "Feeding of Stock on Pasture Land," will be valuable. After pointing out that a very great proportion of the cattle sent to market are insufficiently fed—and after quoting the opinion of an eminent cattle salesman of London, that with very little additional feeding the cattle sent to market might average ten stones per head more than they do—Mr. Wallis proceeds to discuss the remedies proposed to meet this state of matters. He refers at once to the mode of using oil-cake, and other artificial food, in conjunction with summer grazing, as the best means to give satisfactory results. But before this system of fattening can be adopted, he insists upon the necessity of having proper accommodation in the way of shelter-sheds for the cattle in the pasture fields—and further, that the large fields should be divided so as to feed a limited number of beasts in each division. As to the advantages of shelter-sheds or hovels, Mr. Wallis is of opinion that they are as much required in summer as in winter. He says: "We all know how much cattle often sink, in hot weather, in consequence of racing about the fields when gadding. If they were tied up in sheds during that time, and fed with a portion of either cake or meal, and a small quantity of good hay or chaff given to them, this waste would not only be prevented, but they would be rapidly gaining flesh." Again, as to the importance of dividing large fields so as to limit the number of beasts in each part, Mr. Wallis says that unless this is done before the whole could be eaten out, the first portions would be taken, and the weaker animals would be mastered by the stronger and deprived of their fair share of food. A dozen to fifteen cattle is the best number to put together in one field, but twenty is the maximum: The cake is best given in boxes, laid down here and there in the field; one box to each beast.

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## CHAPTER X.

### SUMMER SOILING OF CATTLE.

THE advocates of this system support it by the following arguments, which no doubt deserve the attention of the grazier.

I. By introducing the practice of soiling, a *very considerable saving of land* will be effected. We do not coincide in the extravagant opinions of some writers, or assert that one acre of cut grass soiled is equal to three acres used as pasture; yet in some particular crops, the

saving would be very great, from the absence of all poaching during the growth of the crop, and from the young leaves and blossoms being permitted to reach their full development. There are likewise particular seasons of the year when the advantages of soiling are very great. Sir John Sinclair states that thirty-three head of cattle were soiled from May 20 to October 1, 1815, on seventeen acres and a half, whereas fifty acres would have been necessary had they been pastured.<sup>1</sup>

II. There is also a very *considerable saving in the quantity of food consumed*, as well as a greater variety of plants eaten, and consequently prevented from running to waste; for, when animals are suffered to go upon the field, many plants are necessarily trodden under foot and bruised, or partly buried in the earth; in which state they are not relished by cattle, and are suffered to run to waste—a circumstance that never could occur if the practice of cutting were adopted.

If a close consumption of plants is the object principally to be regarded, it is evident that the benefit to be derived from soiling will be very great; for experience has clearly proved that cattle will eat many plants with avidity, *if cut and given to them in the house*, which they never would touch while growing in the field; such are cow-parsnip, thistles, nettles, and numerous others. It is also well known that many of our best and finest grasses, which when young afford a most palatable food to cattle, are, if once suffered to get into ear, so much disliked by them that they are rarely or never touched, and their produce is lost to the grazier; whereas, if cut down by the scythe in proper time, not one plant would be suffered to become dry and unpleasant to the cattle, and consequently no waste could be sustained from this cause.

In addition to the preceding observations it may be remarked, that the few plants that are totally rejected by one class of animals, are not, on that account, less acceptable to others, but greatly the reverse. Grass, and other food that has been *blown or breathed upon* for a considerable time by one description of stock, seems to have acquired additional relish with stock of another variety. Nay, even greater defilement by one animal seems to render food more acceptable to others; for straw, which in a clean state has been refused by cattle, acquires a taste or smell, if employed as a litter for horses, that induces them to seek it with avidity. Hence it often happens that the sweepings of the stalls of one class of animals will supply a pleasant repast for others, and thus plants are consumed in the house which must have been lost in the field.

III. With regard to the influence produced on the *health and comfort of cattle*, the balance is clearly in favour of soiling. They are not liable to be blown or hoven, or to be staked or otherwise injured by breaking the fences. They are not incommoded by the heat or annoyed by swarms of flies and gnats, and, most of all, they are not driven to a state little short of madness by that most dreadful of all persecutors *the ox warble-fly*,<sup>2</sup> a plague which, to an unthought-of

<sup>1</sup> "Code of Agriculture," p. 487.

<sup>2</sup> The *Æstrus bovis* of Linnæus; *Hypoderma bovis*, De Geer.—The loss caused by the

extent, frequently impedes their thriving. Neither at other times are they injured by chilling blasts or drenched by rains, causes which retard their thriving. Under proper management, and in well-constructed stalls, all these evils will be removed, and the animals kept in a uniform state of coolness and tranquillity; and thus the same quantity of food which one beast would devour or destroy while grazing will suffice for the soiling of two, if not of three.

Lastly, by judiciously mingling green and succulent vegetables with dry and nourishing food as circumstances may require, and by varying the different articles so as to provoke an appetite, not only the health but also the thriving of the stock will be greatly augmented beyond what could have been done by any other mode of treatment. On the whole, the superior condition of the cattle, and the absence of accidents, and many diseases consequent on their exposure to our variable climate, are strong arguments for the practice of soiling, at least so far as the health and comfort of the animals are concerned.

The period of soiling usually commences after the animals have passed their first year. It is not at all improbable that they would retain their health as well as when they were allowed to pasture at large, and would attain a greater weight of carcass and aptitude to fatten, if they were soiled from the period of their being calves; but, as exercise and liberty seem to be natural to cattle during the first year, it may, at least in the present state of our knowledge upon the subject, be advisable for the farmer to suffer his young stock to run at large during that period, if he has the necessary facilities for so doing.<sup>1</sup>

IV. The increase of manure obtained by soiling and stall-feeding further evidences the superiority of these systems over pasturing. *Manure* is the very life and soul of husbandry, and, where tillage is an object of attention, there can be no comparison between the advantages of the two modes of consumption; especially if we regard the manure obtained by soiling live stock with green food during summer, for the increased discharge of fæces and urine during that season speedily converts any species of the litter into manure. There is little doubt but that the quantity of manure made during the summer can, by constructing proper reservoirs for the reception of the stale, and by throwing this at leisure times over the litter, be made to equal, if not exceed, the amount of the dung accumulated during the winter. The *quality* must depend on the nature of the food.

V. With regard to the *quantity of herbage* afforded from the same field, under the *cutting* and *grazing* systems respectively, the balance will be found equally in favour of the former. All animals delight more to feed on the young and fresh shoots of grass than on such as are older. Hence

attacks of warble-flies is not confined to the retarding of fattening, or to the lessening of the flow of milk, but the hides of cattle are greatly depreciated for tanning purposes. Whoever has seen a warbled hide will understand this, and Miss Ormerod calculates that the national loss from this pest, amounts *annually to several millions sterling* (see page 561).

<sup>1</sup> Lewis's "Observations on an Experimental Farm."



it invariably occurs that those patches in our pastures which happen to have been once eaten, bare in the beginning of the season are kept very short throughout the year by the animals preferring them to other parts of the field where the grass is longer, while the latter are often suffered to continue in a great measure untouched.

Another circumstance, not very generally known, is, that grass—even the leafy parts of it—when it has attained a certain length, becomes stationary; and, notwithstanding that it will retain its verdure in that state for some months, yet, had it been cut, it would have continued in a constant state of growth, proportioned to the frequency of its being cropped.<sup>1</sup> Several experiments have been brought forward to prove that with clover, rye-grass, lucerne, and tares, at least *double the number* of cattle may be supported in much better condition when the crops are cut than when they are pastured; hence there cannot be any doubt that, by judicious management in this respect, the profits of the grazier can be greatly augmented.

The practice of soiling and stall-feeding cattle was adopted to a considerable extent on the Continent by Baron von Bulow and others, the results of whose experience are inserted in the first volume of the “Communications to the Board of Agriculture,” by Dr. Thaër, Physician to the Electoral Court of Hanover:—

1. “A spot of ground that, when pastured upon, yields sufficient food for only *one* beast, will abundantly maintain *four* head of cattle in the stable, if the vegetables are mowed in proper time, and given to the cattle in a proper order.

2. “The stall-feeding yields at least double the quantity of manure from the same number of cattle, for the best and most efficacious summer manure is produced in the stable, and carried to the fields at the proper period of its fermentation; whereas, when dropped on the meadow, and exhausted by the air and sun, its power is materially wasted.

3. “The cows used to stall-feeding will yield a much greater quantity of milk, and increase faster in weight when fattening than those which go into the field.

4. “They are less subject to accidents—do not suffer by the heat, or from flies and insects—are not affected by the baneful fogs that are frequent in Germany, and bring on inflammations; on the contrary, if everything is properly managed, they remain in a constant state of health and vigour.”

The system under discussion is just one of those which are apt to captivate the fancy of the enthusiast and cause him to imagine that the profits of cattle feeding and dairying can be at least doubled by following it. Zeal is an admirable thing so long as it does not outrun discretion, but when the hobby-horse is mounted there is no knowing where its career will end. And so with this system of soiling, its advocates in rightly praising its usefulness have too often forgotten to

<sup>1</sup> See Dr Anderson's “Essays on Agriculture,” &c., vol. ii., Disquisition v., where this interesting fact is corroborated by experimental proofs, which our limits forbid us to introduce.

point out its limitations. As already mentioned, one of the most prominent of these is the fact that only on land capable of producing a good crop for mowing could it possibly answer, and this at once places a large proportion of British land beyond the pale of the discussion. Then comes the question of labour, and every one knows that one of the chief causes of the steady but constant increase in permanent pasture has been the determination evinced by farmers to cut down the labour bill. In many districts farms can be found which used to employ ten men and now can only boast of the services of two or three. We hear much of the attraction of towns and the "rural exodus," but the economy which low prices have forced on farmers has probably been the moving force in the lamentable depopulation of the country side. At any rate, the men have gone and wages have risen, rendering the adoption of the soiling system on thousands of farms quite out of the question. It is, however, our desire to be impartial in our treatment of this subject, and we shall find something to say on the other side. We regard soiling in its relation to grazing much the same as we should the use of the spade as opposed to the plough for intensive arable cultivation. It is, in short, the intensive farming of pasture land. The late Mr. George Simpson of Reigate had a very considerable herd of Jersey cattle for which he was justly celebrated, and few of those to whom his beautiful cattle were so well known were aware that he only occupied about fifty acres of land. How could he possibly have maintained his numerous head of stock on the old grazing system? Another case was that of Mr. Swan at Lincoln who kept a herd of eighty head of dairy Jerseys near that town on the same acreage as that of Mr. Simpson. In his case, however, the land was all or nearly all under the plough, and was devoted entirely to the growth of green crops and roots, which, of course, had all to be carted to the cattle in the yards. With the close proximity of the city of Lincoln which Mr. Swan served with dairy produce, his heavy expenditure was justified by results.

When pasture land is constantly mown we have not only to consider the expenditure involved in carting the grass to the yards but also the great additional outlay for heavy manuring which is absolutely necessary for maintaining the land in condition. There is another point also which should not be forgotten. When grass land is mown every year, whether manured or not, there is always a tendency to change in the nature of the herbage. Many of the finer grasses and clovers die out leaving only the coarser kinds, whereas the former flourish when grazed. Skilful graziers frequently argue that first-class old pasture suitable for grazing should never be mown at all for this very reason, and an old Warwickshire farmer known to the writer, used to advise his sons to "mow your mowing grounds and graze your grazing grounds." Doubtless he had a double reason for giving this advice, and took into consideration the character of the soil itself. The best grazing land, in every sense, would probably be that which was sound in texture, and would therefore take far less injury from "poaching."

In soiling from permanent pasture we must also notice a difference which may exist in its effects on the production of beef and butter respectively. Every dairy farmer knows the bad influence on the latter of certain noxious weeds, and when the grass is mown all these are eaten by the cows which they would refuse while growing in the field.

All this leads us up to the consideration of a very important point, viz. :—Whether, if soiling is to be done, a permanent pasture is the best for the purpose. We think there is a forage plant, now coming rapidly to the front which is infinitely superior from every point of view. We refer to lucerne, one of Nature's very best gifts to the cultivator of the soil, and one which has been too long neglected. It has been known for many years to a very few and was grown in this country, to a small extent, half a century ago, but rarely in larger patches than an acre or two. Yet no farmer who tried it on anything like suitable soil ever gave it up, and it is simply marvellous to any one unacquainted with the extraordinary reluctance of British farmers to leave the beaten track, that its many and great merits should have remained so long in the background. It is essentially a soiling plant and would probably distance any rival as material for silage, but for that to those who have proved its virtues it would be considered too good. Not that it would really be so, because the better the material used the better will be the silage, but the common idea is that silage is silage and of equal value of whatever it may be composed.

A good thing must in the nature of things be recognised in time, however long its appreciation may be in coming, and at last we are glad to see a decided increase in the acreage under lucerne in Great Britain. It is still only very small in comparison with the area devoted to clover and rotation grasses as will be seen from the following figures:—Of these last in 1907 there were 4,491,028 acres under cultivation, showing an increase of 50,280 acres over 1906. Of lucerne there were only 63,796 acres in 1907, but the increase on 1906 was 8,062 acres, or 14·5 per cent., while the increase in clover and rotation grasses was only 1·1 per cent. This is satisfactory so far as it goes, and it is a good sign that the cultivation of the plant is spreading in certain districts with great rapidity, thus showing that it grows in favour from the results of ocular demonstration. In certain parts of Essex the farmers are planting great breadths every year, and a very shrewd farmer on Romney Marsh, in Kent, having tried it, with some caution at first, is now using it extensively and is finding many imitators.

But we are speaking of soiling, and we must now see what peculiar advantages it possesses for that purpose. First then, it will produce three good crops in the year, the first being ready by the end of May. It is undoubtedly a rich and nourishing food and perfectly safe. It never produces "scour" like tares and many other green crops. Indeed, given to lambs folding on young tares it is a splendid corrective and astringent for counteracting the well-known deficiencies of that watery food. Horses fed with it will work hard all summer and get fat without oats, and last but not least, it is a capital diet for dairy cows producing

a flow of milk equal, if not superior, to that obtainable from any other forage.

The following appeared in "Country Life" in its issue dated 22nd September 1906:—

"Over a large portion of England, and especially in the southern half, the summer of 1906 will be remembered as one of severe drought. The corn crops have been good as a rule, the roots got a fair start, and even the hay crop, particularly in some counties, was not so very bad: but since haymaking the pastures and seeds have been burnt up and parched till large areas have assumed the appearance of an arid desert.

"I have lately travelled over a wide stretch of country, westwards to North Oxfordshire, and eastwards through Essex, and in a tolerably long experience have rarely seen a more depressing state of things than that from which the graziers and dairy farmers are now suffering. There is literally nothing in the meadows for the cattle to eat, and the sheep, cropping close to the ground, are just keeping themselves alive, but sinking in condition day by day. At such a time as this it would be difficult to estimate the value per acre of a succulent forage plant which, in spite of such a drought as the present one, can yield two good crops of hay and then throw up an aftermath in the course of three weeks nearly up to the knees of the cattle. And yet we have in lucerne just such a plant as this, useful in any season, but in a dry summer simply invaluable. The secret of its ability to withstand a lengthened drought is the wonderful way in which it strikes its roots right down into the subsoil, often to a depth of 3 or 4 feet. Forty-two years ago I grew a small patch of lucerne, and quickly perceiving its value, I soon had 30 acres of it growing on a gravelly soil. It was able to find moisture, and produce abundance of fodder quite independent of the weather. Only last week, on a hill farm in Essex, I saw this plant behaving in exactly the same way, and after two excellent mowings, the third crop was keeping all the farm stock and producing a covert for partridges into the bargain. From May to October horses fed upon it will become fat and require no corn: whether as hay or green food there is nothing better for a herd of dairy cows; sheep of all ages thrive upon it, and young lambs will never scour, as they often do when weaned upon tares. Besides all this it is inexpensive to cultivate, and once started with a good thick plant will last for many years.

"A few hints with regard to the best treatment for lucerne may be useful, and those given are derived from personal experience. There are few soils on which lucerne will not thrive, but those of a warm and calcareous nature are considered the best, and a cold retentive clay is probably the worst. The land intended to be sown should be autumn cultivated, cleaned thoroughly, and deeply ploughed or ridged for the winter. It should not be ploughed in the spring, as a fine surface is essential for a seed-bed. It may be sown with barley or oats, but I should strongly advise otherwise, as the chances of a thick and even plant are far better when sown alone. The first week in April is the best time for planting, and the quantity of seed per acre should be at

least 20 lbs. This may either be drilled or sown broadcast, preferably the latter, provided care be taken to ensure even distribution. The great point is to get the ground well covered, and if this be done successfully weeds will be smothered and the plant will be sure to take care of itself. It has been recommended to drill wide apart, and then cultivate with the hoe—an endless expense which I think unnecessary. A word of caution as to close grazing by sheep must here be added. It is much better to allow the crop to grow and fold them on it than to graze it as you would clover or sainfoin, because by the former system the surface weeds are kept down. I have said nothing about manuring, but, although it is doubtful if artificials are much use, a good dressing of farmyard manure, rendered free of the seeds of weeds by turning and well fermenting the heap, and put on in the previous autumn, will assist the young plants to start a rapid growth. With the liberal treatment advised, two fairly good crops will be produced the first year.”

In two or three years the crop will take care of itself. But while there is no question as to the value of the crop, it must be admitted that there is a difficulty in inducing it to grow on some soils. Deficiency of lime, in some cases the cause of failure, may be met by chalking or liming the land. As for other difficulties, a small quantity of soil from a good lucerne field spread over the land has removed them in most trials, and it may prove that the easier plan of inoculating the seed with a culture of the proper bacteria, such as Professor Bottomley sends out, would succeed.

The facts and inferences above stated fully prove the advantages of soiling. It ought not, however, to be concealed, that there are some inconveniences attendant on the soiling and stall-feeding of cattle, such as the additional labour and expense incurred by cutting and carting the green vegetables home to the sheds, both in winter and summer; but these are more than counterbalanced by the saving in food that is effected—by the increased productiveness of the land and the diminished waste—by the thriving of the cattle—the making of the dung under cover, and having reservoirs in which to preserve the urine. Under proper management one good acre of turnips will produce an excellent dressing of manure for at least an acre of land, and, with a very small portion of hay, will completely winter-fatten an ox of fifty score pounds. If fed on the land, two acres of tolerable grass may fatten an ox; but not so well, nor will he make flesh so rapidly, if exposed to the weather in all seasons, as if kept dry and moderately warm; the dressing, also, will be very partial and precarious.

It has also been objected, that where large quantities of food are accumulated for a prolonged time they are liable to fermentation, and of course to waste. Such is the case with cabbages, turnips, and other roots, but it may to a very considerable degree be obviated, by paying due regard to the storing of the various vegetable crops, and their economical consumption.

It has likewise been objected by the opponents of soiling and stall-feeding, that the cattle are heated by being confined during the summer

months, and that their health is injured ; but this will never be the case where stalls are so constructed as to admit a regular circulation of air, and yet afford shelter from the attacks of flies. The cattle may also be allowed the freedom of an open yard ; indeed, in that season, *fold-yards*, with open sheds, are by many preferred to stalls. This is the practice in Yorkshire, where the management of stock is well understood ; and there is no scientific grazier who is not a strong advocate for perfect ventilation even during the inclemency of winter. Plenty of good and wholesome air is indispensably necessary to the preservation of the health and the speedy fattening of animals.

When grass (whether natural or artificial) is to be given, it should be cut in the morning for the evening food, and in the afternoon for the morning. The afternoon crop should be carried to the barn, or some other convenient place, and spread out in order to evaporate its superfluous moisture ; and in rainy weather both crops should be taken off the ground. Attention, however, should be paid to the due proportion to be cut ; and, until this is ascertained, it is a good plan to measure each mess, and to chalk down the quantity *in weight*, which the basket, cart-body, or other vehicle employed for carrying food, contains. This practice will, at least, have a tendency to teach farm-servants to observe *method*, the value of which is of considerable importance in all business, and in none more so than in the various subjects that are connected with husbandry. In the early part of the season, either when tares and clover are inadequate to the support of the stock, or when it may be thought expedient to change the stock gradually from dry to green food, a portion of these grasses may be mixed with the hay or other provender on which the cattle are fed ; and if the mixture is made up over-night, the dry provender will be found to have acquired a sweet and pleasant odour, and to be rendered so moist and palatable as to be readily eaten.

In concluding our remarks on the subject of summer soiling of cattle, we would caution our readers on one or two points connected with it. Like all other departments of practical farming, its success depends upon, and is greatly modified by, circumstances of locality, soil, and climate ; so that a system which may be well adapted for one place will not be so for another. It would, for example, be in vain to expect good, or at least economical results, from the adoption of the system in hilly districts, where the pastures are not only poor, but uncertain in growth, and the climate is variable and ungenial. In such localities the best that can be made of the land is to graze it, the farmer using his judgment as to the kind and quality of stock best adapted for the pasturage.

Soiling, to be successful, must have fine rich land for the raising of that succession of crops which is the very foundation of the system : and this land must be perpetually kept in good heart. So that another element of success is good farming. Climate has also a great deal to do with the system, and the most favourable is that not so much characterised by high temperature alone as by an association of warm sunshine with light and refreshing showers. This aids most effectually the cultivation of the succulent plants and grasses demanded by the system. Where

the temperature is normally high, yet the locality not much favoured on the average with rain, it is obvious that the adoption of irrigation will yield good results.

Another point demanding attention is labour. The system obviously is one in which a great deal of work on the part of the attendants is required. This is not heavy, but it is constant. The right direction and management of labour, then, will largely decide the success or non-success of the system. Labour-saving appliances should be unsparingly used.

Whilst, finally, it is easy to instance many minor advantages that may be placed to the credit of the summer soiling of cattle, it is seldom found profitable to follow the practice except with dairy cows on highly farmed lands in the vicinity of large towns where land is relatively dear and labour is cheap in comparison. Dairy farmers in the neighbourhood of Edinburgh and Glasgow, for example, generally keep their cows in the byres summer and winter. On the other hand, the farmers at a distance of a few miles from such large centres of population never soil their cattle in summer, except perhaps during the last few months of their lease, when they happen to have a lot of straw to convert into dung, and the dung has to be taken over at a valuation. There is, as has been remarked, much extra labour with summer soiling, as the fodder has to be cut and carted to the cattle, and the dung from the courts has to be carted out again and spread over the fields, all of which involve a considerable outlay for labour. Summer soiling has been abundantly tried, and, if it were more profitable than grazing, it would have been more extensively adopted.

As the various grasses adapted for grazing or soiling cattle will be particularly detailed in Book the Tenth of this work (page 893 *et seq.*), we proceed now to enter on the subject of winter or stall-feeding, or box-feeding.

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## CHAPTER XI.

### OF WINTER BOX AND STALL-FEEDING CATTLE.

**T**HERE are various opinions as to the best and most profitable way of accomplishing this branch of the grazier's occupation. The commonest way is to keep the stock in sheds surrounding open folds or yards, and to tie up the actual fattening cattle, and leave the others at liberty; but here the rain and the rain-water from the roofs of the sheds descend upon the manure and wash all the finest particles away. Stalls or sheds in which the fattening cattle are tied up in couples, or sometimes singly, is the next system. Here the litter is changed twice or thrice a week, and consequently, unless the reservoir for the manure is very well arranged, loss must ensue.

In well-arranged stalls there are shutters which may be used whenever the weather is inclement, and the cattle and stalls are regularly cleaned and attended to.

“Mr. Dobito,” as we have elsewhere remarked, “is a great advocate for the *stall-feeding* system for ordinary purposes. He does not recommend it, however, for young beasts that are to be summered again, or for prize oxen. The young beasts should have well-sheltered yards, with high fences, to keep them from looking over, and good-shelter-sheds. The prize oxen should be housed in loose boxes, with plenty of room in each for the animal to walk about in. If well arranged, Mr. Dobito says that there is no system equal to that of stall-feeding; it is the abuse of it which has got it into disrepute with some. The fattening-house should be well paved and provided with surface drains to carry off the liquid manure into tanks provided for its reception. Shutters should be placed in the walls to regulate the heat, and wide passages at their heads to clean the mangers and feed them readily. The advantages of the stall-feeding system are the small quantity of litter required, which makes the manure better, the easy regulation of the temperature, and the quiet secured to the animal, so that it can eat its share in peace. The disadvantage is, that the animal cannot freely rub or lick itself: this, however, is got over by using the round brush, which is recommended.

“Mr. Dobito thinks that stall-feeding is not commenced early enough. As soon as the weather becomes damp and the days shorten, say in October, the grass begins to lose its fattening properties; the sooner, therefore, your stock is housed the better. When put up thus early they receive turnips. Along with the turnips they have given to them half a stone of pollard or bran, with an equal quantity of hay or straw chaff. The bran, although considered loosening, Mr. Dobito finds to have the singular property of preventing the loosening action of the watery turnips. This style of feeding, although it does not fatten the beasts, yet brings them into the condition best fitted to enable them to make the most of that artificial style of living which is to take them through the winter.

“Early in November the food is to be changed to swedes, oil-cake, &c., in the following rations:—Morning’s meal, one bushel of swedes, well cleaned from dirt, cut small by machine; then, the refuse pieces being well cleaned out, a dry bait consisting of 2 lb. of oil-cake, 3 lb. of pollard, and a little hay chaff. While feeding, the manure and litter to be cleared, the floor swept clean, and plenty of fresh litter put in: every bullock is then to be well brushed with a dandy-brush,—that is, a brush made with whalebone. After all this, the animals are to be left quiet till after dinner, when another bushel of swedes is to be given to them in small quantities, followed by a dry bait of cake, pollard, and chaff, with the addition of 3 lb. of bean-meal: this is left with them at night. The shutters should be closed or opened according to circumstances, the object being to maintain an even temperature—warm without inducing perspiration. It is essential to have the



manger well cleaned out after every meal. After a month or so feeding on the above, the quantity of cake may be increased, and if more convenient the swedes may be changed for mangel-wurzel. Never change, says Mr. Dobito, from mangel-wurzel to swedes, or the animal will not get on so fast; but if mangels are more plentiful than swedes, and you therefore want to begin to use the mangels earlier, you have only to leave them exposed to the air for a week or two to wither, and they may be used as early in the season as you require.

"Cleanliness, warmth, and quiet are what Mr. Dobito insists upon, of course coupled with good feeding; but he says that very many tons of good oil-cake are wasted through the comfort of the animals not being attended to. He also claims the credit of introducing a cheap food in the form of pollard, or miller's offal, as it is otherwise termed."

A more recent system, however, is that of box-feeding. This consists in enclosing the cattle in boxes about eight or ten feet square and twelve feet high. The animals are not tied up. These boxes are sunk in the ground from two to three feet, and in the excavation, or tank, thus formed, the manure is suffered to accumulate until it rises to the level of the external soil. Thus a mass of straw saturated with excrementitious matter is obtained and preserved intact until it is required for some portion of land; all that is necessary is to strew about 18 lb. of fresh straw over this bed of manure every day, and not a particle of fertilising matter will be lost. The animals, being free to move about, trample the whole into a compact mass, and will lie down on it without appearing inconvenienced by the exhalations from it, and certainly without suffering in appearance or health. Indeed, numerous experiments tend to prove that this is one of the most economical and advantageous ways of feeding cattle for the butcher. It is not, however, adapted for breeding cattle, as they require more air and exercise to develop their powers.

These objects are attained by the system of "hammel-feeding," as it is termed. A hammel consists of a small shed generally having about 144 or 150 square feet of surface: this opens out to a small court-yard about the same size as the shed, having a gate leading into it through which the hammel is supplied with straw, and the feeding-troughs—one in the shed and the other in the court, a water-trough being generally placed in the latter—with food. In the hammel, while shelter is given to the animal, it has at the same time the great advantage of air and exercise. The great weight of practical evidence is in favour of the system of hammels as opposed to stall and box-feeding. Thus, to quote from one only of the many reports on the subject, Mr. Templeton of Clanbage, Holywood, Ireland, in a Prize Essay in the "Transactions of the Highland and Agricultural Society of Scotland," on the "Best Modes of Housing, Soiling, and Pasturing Cattle," says, "that the cattle in all cases made the greatest improvements in the hammels, and the lots which had 3 lb. of linseed-cake per day made a fair return for the cake consumed." The litter used in hammels is moreover less by one-third than that required for stall-feeding.

Mr. Gilbert Murray, writing (1890) in the "Journal of the Royal Agricultural Society," as to his practice in Derbyshire, says:—

"For rearing and fattening cattle we prefer well-arranged covered sheds and yards on the North-country hammel system. We have only a wall on one side, and two gable-ends, whilst a feeding-passage extends the whole length of the building: this secures a great economy of labour, and saves the cattle from disturbance. The sheds and yards are divided and enclosed by ordinary iron gas-pipe varying in diameter from  $\frac{3}{4}$  in. to  $1\frac{1}{2}$  in.; these pipes are passed through iron standards securely bolted to stone blocks placed 9 feet apart. The eaves of all buildings are spouted, and the rain-water is conducted to a well. The manure is not removed more than twice a year; the litter absorbs the urine, and, if the rain-water is excluded, under drains are not necessary. Contrary to the opinion of those unaccustomed to covered yards, the manure comes out in a ripe state; the constant treading of the cattle solidifies the manure, and prevents excessive fermentation. The winter-made manure comes out when the turnip season arrives, and is in a fit state to apply to the land at a temperature of  $70^{\circ}$  to  $80^{\circ}$  F. We look upon this as a considerable advantage, as when taken direct from the yards, and placed in the ridges, it raises the temperature of the soil and hastens the sprouting of the seeds."

As giving some details of feeding, and as bearing upon the subjects of the pasturing and stall-feeding of cattle, the following, from a Prize Essay by William Adam Eye, of Ranna, Aberdeen, in the "Transactions of the Highland and Agricultural Society of Scotland," will be useful:—

"The cattle experimented on were twelve two-year-old queys, crosses between the Aberdeen and short-horned breeds. They were brought in about the middle of June 1851, and after having been kept in the same pasture till July 10, were divided into three lots (four in each lot) of as nearly the same value as possible, by the reporter's farm-overseer and an experienced butcher, both considered good judges.

"The *first* lot of four were pastured out of doors, in a field of excellent first year's grass, consisting of rye-grass and clover, but principally of red clover. The part of the field railed off for this lot consisted of 3 acres 2 roods 6 poles. It was well sheltered on the north and north-east by a belt of thriving wood, and had in it an abundant supply of good spring-water. It had been well laid down after turnips, and afforded a good supply of food for the lot put upon it up to October 12, 1851, when they were removed and very soon after sold, along with the two other lots, to the same butcher.

"The *second* lot of four were tied up in stalls (two and two in a stall), and received daily as much of the same description of green cut rye-grass and clover as they could eat during the same period (from July 10 to October 12, 1851). They were regularly fed at stated intervals during the day, and watered once a day, and had an abundant supply of litter. They were also curried once a day. The

extent of ground required to supply this lot with grass, part of which was cut twice, and part three times, was 1 acre 2 roods 35½ poles.

"The *third lot* of four were also tied up (two and two) in stalls, and received as much of the same description of rye and clover grass cut green as they could eat, with a like supply of water and litter. They were also curried once a day, and, in addition to the cut grass, each of the cattle composing this lot received daily a small allowance, by measure, of bruised oil-cake, and of bruised linseed and light oats. The extent of ground required to supply this lot with green provender, during the period of the experiment, was 1 acre 2 roods 35½ poles.

"All three lots thrived exceedingly well, but it soon became apparent that the lot receiving the oil-cake and bruised linseed and oats, were advancing before the other two lots, although it was doubtful so much as to justify the expense of this food. The progress of the first and second lots seemed so equal during the period of the experiment, that no two judges who saw them could agree as to which lot had the advantage of the other; but the third lot continued to maintain its superiority during the whole period of the experiment.

"It thus appears that there was a gain on the lot fed in the house on cut grass alone, over the lot pastured in the fields, of 3*l.* 16*s.* 8*d.*, and that on the lot which received the addition of oil-cake and crushed linseed and light oats, there was a gain over those pastured in the field of no less a sum than 8*l.* 8*s.* 2*d.*, and over the lot fed in the house on cut grass alone, of 4*l.* 11*s.* 6*d.*, proving beyond a doubt that high house-feeding is the most remunerative to the farmer.

"It may be proper to add that as the whole grass on the farm had been pastured by sheep during the winter, and till far into spring, and very closely eaten, it was later in the season before it could be either pastured by cattle or cut for soiling than otherwise it would have been."

There is one circumstance, however, that should never be forgotten by the farmer—that, valuable as stall-feeding is, it will not suit all cattle, and particularly lean cattle. The stall-feeding system should not commence until the animal is half or three parts fat. The grass will seldom carry him farther, and the season is approaching in which he would necessarily decline.

Stall-feeding, then, usually commences about the end of October, and lasts nearly seven months, or until the commencement of May. Of all vegetable productions *good hay* is undoubtedly the best for fattening cattle; yet, except on the most luxuriant soil, a sufficiency of it can rarely be obtained for finishing them off for the market; hence it becomes necessary to have recourse to other things in combination with it, as cabbages, carrots, parsnips, turnips, or other succulent plants, or oilcake. Barley, rye, oat or pea-meal, if mixed together, in about equal proportions, with the occasional addition of a small quantity of bean-meal, may likewise be given with advantage, if the price will admit of it, in the ratio of a quarter, or at most half a peck, to the beast, in conjunction with cut hay. Of the last-mentioned article it may be observed,

that the hay made from grass mowed after the cattle, is usually employed for feeding live stock at the beginning of winter, the best being reserved for the spring; and where a few pounds of salt have been thrown over each load, when stacked, it is grateful to cattle, so that they have been known to prefer poor hay *salted* to good hay *untouched*. Salt acts as a condiment; it assists digestion; and evidently is eaten with avidity by most ruminating animals. In recent wet seasons a large quantity of hay was obtained in such bad order that many modes were suggested by which it could be made more valuable for feeding purposes. In "Bell's Weekly Messenger" Mr. Bowick suggested:—

Fenugreek (powdered)	. . . . .	112 lb.
Pimento	. . . . .	4 "
Aniseed	. . . . .	4 "
Caraway	. . . . .	4 "
Cumin	. . . . .	2 "

These to be mixed, and the mixture strewed on the hay in layers, as it is built in the stack. Mr. Bowick does not offer this as the best to be made, but he gives it with confidence as a safe, reliable, and valuable compound for the purpose indicated.

The most luxuriant of all vegetable productions, perhaps, is the *cabbage* with its numerous varieties, which, when combined with cut pea- or oat-straw, has been found singularly useful as winter fodder for *store stock*; and which, with the addition of good hay, will fatten oxen or bullocks rapidly, besides yielding a larger quantity of manure than almost any other material used for winter feed.

Dr. Voelcker says that no green food cultivated on the large scale contains so much nutritious matter as cabbages. Cattle, moreover, are very fond of them; and for calving cows they are specially valuable, as they increase the flow of milk.

*Kohl Rabi* has steadily grown in favour as a feeding material, especially for milch cows. This root is more nutritious than white turnips, and "fully equal if not superior," says Dr. Voelcker, "to swedes and mangel. . . I may remark, with respect to the kohl rabi, that it is an excellent food for milch cows, inasmuch as it produces rich and good milk: the butter made of such milk has a pleasant taste, altogether unlike the disagreeable flavour that characterises butter made from the milk of cows fed upon turnips."

The late Professor Baldwin, Inspector of the Agricultural Schools in Ireland, who wrote so many papers of value on farming subjects, experimented extensively on the feeding value of kohl rabi, and detailed the results in the "Irish Farmer's Gazette." These do not show the high value which some put upon this crop. The cattle did not like the stems, and Mr. Baldwin concluded that, weight for weight, swedes were superior to them. Moreover, upon the farm land upon which the two crops were sown, the swedes yielded 25 tons, the kohl rabi only 13½ tons per acre.

*Parsnips* have been employed not only for feeding store cattle, but particularly for fattening oxen, which eat them most advantageously; the benefit thence derived being, in the estimation of some graziers,

nearly equal to that obtained from oil-cake ; but they are apt to cloy the appetite, and should therefore be given with other food, or if alone, they should not be continued for a long time together. The flesh of animals fed upon parsnips is said to be of rich flavour and juicy.

Next to the parsnip we may class the *Carrot*—a most useful root, more grateful to cattle, and better calculated to be a constant food, than the turnip. It is particularly valuable for feeding horses.

*Mangel-leaves and turnip-tops* are often used as food for cattle, but they do not rank high as a nutritious food ; they are apt to scour the animals partaking too freely of them ; they should therefore be given only in moderate quantities and along with other more binding food.

Mr. Hillyard, an excellent authority, thus speaks of the mangel : “ I have often been asked which I preferred, this or Swedish turnips ; my answer has invariably been, for some purposes I prefer one, and for some the other. For stall-feeding until the spring, turnips are the best ; but at that season the turnips having lost a portion of their nutritive quality, and the mangel from keeping, having lost much of its watery particles, and thus improved, I then prefer the latter.”

“ Mangel should not be given to stock for some time after being taken up—say towards the latter end of December, or the beginning of the year—as, when first taken up, they possess an acrid principle which has a tendency to scour the animals. This disappears after a few months' keeping, and the nutritive value of the root is increased. The superiority of old stored to newly-taken-up mangel must not, however, be attributed solely to this, but in no small degree to the change of the pecten into sugar. Dr. Voelcker mentions the fact, that his experience shows that mangel are the worst description of roots that can be given to sheep. ‘ Two years ago I found this to be the case, when feeding various lots of sheep, with a view of ascertaining practically the relative value of different feeding materials. For several days the sheep refused to eat the sliced mangel, and were content with the small quantity of hay which was given to them at the same time ; and only after four weeks they became in some degree reconciled to the taste of mangel, but did not get on well upon this food. Although these sheep were supplied with a fixed and limited quantity of hay, and as much sliced mangel as they would eat, I found at the end of four months that they had not increased a single pound, whilst my experimental sheep, fed upon swedes and hay, increased, on an average, at the rate of 2½ lb. per week. On further inquiry, I have learned that this observation is confirmed by many practical feeders. . . . This peculiarity of mangel thus shows that a feeding substance which, like this root, is justly esteemed on account of its fattening properties when given to beasts, may not possess any great nutritive value when given to sheep. Another direct proof is here afforded of the fact that the chemical composition of food does not solely determine its adaptation to a particular purpose ; for, like mangel, other feeding materials may be rich in nutritive substances, and valuable when given to fattening beasts, whilst they may not agree at all with the constitution of sheep.’ ”

*Turnips* supply a nutritive article of winter food, although, from their

peculiarly moist nature, they require to be associated with cut hay, to which a little barley or oatmeal may occasionally be added.

When the fattening process commences, the *white* turnip will perhaps be preferred. It is cooling and slightly aperient. The quantity allowed for each beast should be, on the average, a bushel and a half per day. To this should be added twenty-four pounds of cut hay, and about two quarts of meal mixed with the hay. The *white* turnip, however, must soon be changed for the swede, one of the most useful plants that was ever brought into our country.

The old Norfolk farmers used to give these turnips whole, and with more freedom from accidental choking than would be thought possible. It sometimes, however, happened that the turnips would stick in the throat and threaten to suffocate, or actually destroy the animal. In this event a probang should be gently pushed down the throat, with the object of pushing the turnip into the stomach; or half-a-pint of olive oil should be poured down, to make the turnip slip either up or down, pressure being used externally.

Should the turnip still obstinately stick in the gullet, a veterinary surgeon must be summoned, who will cut down upon the obstruction, and remove it without difficulty. Turnips are now commonly sliced for stall-feeding, though some of the best and most extensive feeders in Scotland still give whole turnips to the cattle. Many others give the roots a single stroke with a four-bladed chopper, after they have been thrown in the stall. This has the effect of cutting the turnip into four pieces. On this point it is important to notice that in the great feeding districts in the north-east of Scotland, whence come so many of the fat cattle for the London Christmas market, the practice of pulping the turnips is rarely if ever adopted, as the butchers and dealers in that quarter who send the great stocks to Smithfield, manifest a most decided objection to cattle that have been fed on pulped roots. They hold that the cattle which have "broken their neeps themselves" come out much fresher after the long and fatiguing journey to London than animals which have had their roots pulped for them.

If the beasts do not thrive, oil-cake may be added to their food with advantage. When cake is thus given, the practice of skilful feeders is to reduce the allowance of turnips and to give more fodder.

Linseed has been given by some graziers instead of the oil-cake; on account of its oleaginous nature, however, it requires to be mixed with other and less nutritious substances. Some bruise and steep it four or five days in cold water, or two days in hot water, until it becomes a jelly.

The Swedish turnips, or swedes, may be continued until after Christmas, and then, as they will have lost much of their nutritive power, whilst the mangel will have improved, the latter should be given chiefly or entirely. In Scotland, however, where very little mangel is grown, the white or yellow turnips are generally used first, and after Christmas the swedes are the staple article of winter feed until the grass comes round again.

Among the various vegetable productions that have been appropriated to the stall-feeding of cattle, none have occasioned greater discussion than *Potatoes*. They furnish an excellent supply, particularly when cut and steamed; and, as will be seen from the subsequent facts, they appear adequate to the fattening of neat cattle in combination with a comparatively small portion of other food. Some practical men, however, are much opposed to the use of potatoes for cattle.

In the eleventh volume of the "Annals of Agriculture" we meet with the following statements relative to these tubers, from Mr. Campbell, of Charlton. He observes, that "100 bushels of potatoes and seven cwt. of hay are generally sufficient to fatten any ox that thrives tolerably well. The roots should at first be given in small quantities, and gradually increased to one or two bushels per day; dry food being always intermixed, and the proportion of hay being uniformly regulated by the effect which the potatoes produce on the bowels. There should be at least *five servings* in the day; and, according to the quantity of roots which a beast can be induced to eat with appetite, will be the rapidity of his fattening, the diminution of expense, and the increase of profit. The hay should be cut once or twice along the truss and three times across it, so that it will be in square pieces of eight or ten inches, in which state the cattle will eat and digest it more readily, while their fattening is considerably expedited." The potatoes, however, according to Mr. Campbell, need not be cut, except at first, in order to entice the beasts to eat them; but they should always be *fresh* and clean. No corn or meal is necessary; yet, if it can be procured at a moderate price, it will contribute materially to facilitate, and of course to render more profitable, the whole system of cattle-feeding. Should purging be brought on by the use of raw potatoes, which frequently happens, the quantity of meal or other dry food should be increased until the beasts have become accustomed to the roots, when this inconvenience will generally cease.

Potatoes, however, being an article of constant consumption in our markets, and having been of late years diminished by disease, are more subject to variations of price than any of the other crops commonly used in fattening cattle. The grazier must, therefore, be governed by the consideration of their comparative cost, as well as quality. The cultivation of potatoes is also expensive; and there is no doubt that they exhaust the land. In consequence of this they are seldom resorted to as a fallow crop, even on soils best adapted to them, while in some of the best grazing districts the ground is too strong and heavy for their growth. It should further be remarked, that they have often been found prejudicial to the health of cattle, when given for any length of time in a raw state.

In some districts where winter food is with difficulty procured, *heather* may be advantageously resorted to. In a paper on this subject communicated to the old Board of Agriculture by Mr James Hall, he states that, in the course of numerous experiments on furze, broom, rushes, bean-straw, and other neglected articles, he had discovered that, if heather is cut when young and in bloom, and the finer parts

infused in hot water, it produces a liquid very grateful to the taste, eagerly drunk, and extremely wholesome.

Being anxious to know how far young heath might be useful to cattle, he tried the experiment on a cow. When first tied up, she refused to eat any of the heath, except the very finest part, nor did she appear to relish an infusion of it when set before her; hunger, however, compelled her first to drink the infusion, and then to eat the heath; and on this food alone she lived for nearly a fortnight, during which time her milk was reduced in quantity, although its quality was much improved.

Satisfied from these experiments that cattle may be long supported by young heath, Mr. Hall proceeded to ascertain how far the plant was capable of retaining its valuable qualities when dried and laid up. He therefore cut some at the end of the summer, and dried it in the shade; and, at the end of two years, it produced an infusion as strong and well-flavoured as at first. The effect was the same at the end of three years.

Young heath may be procured by burning the old which remains on the ground. The ashes afford an excellent manure, and generally cause a fine young crop to spring up, that will afford nourishment for the stock in the ensuing months of August and September.

As food for sheep, it forms the chief portion of their sustenance on mountain pastures during the latter part of autumn and the beginning of winter.

*Furze, gorse, or whin* (see p. 939), as a butter food for dairy cows, is considered valuable by some farmers. Cows are fond of it, and it is said to counteract the bad flavour given to milk by turnips. From an account of a farm in Warwickshire, where furze is grown and used, we gather the following particulars. The furze meadow consists of ten acres. Its produce—with a feed, every twenty-four hours, of turnips, mangel-wurzel, potatoes or grains, given to counteract the richness of the furze, and without any hay—supported for the winter half-year twenty-one head of milch cattle and six horses of the large German breed, all of which were in high condition. The cows milked remarkably well, the milk and butter being of excellent flavour. The owner had also sold off the same field 25 tons of furze, at 20s. per ton, and having about as much more left he had it cut and burned, as it is necessary to cut it every year. The saving of hay alone was calculated at 100*l.* per annum. The furze prickles require to be broken by a furze breaker or machine, before being given to the cows.

In an article which appeared in "The Dairy" (Oct. 1889) on gorse as food for dairy cows it is stated that as a winter fodder for dairy cattle the claims of furze have often been urged, and the fact that it is available in winter is not one of the least of its merits. A vagrant, found upon the poorest and lightest of soils, it is too often allowed to waste its sweetness upon the desert air, when it might, with very little trouble, be converted into milk and butter. The excellent quality of gorse—young growths, bruised and cut—as a supplemental food for dairy cows, has long been placed beyond the region of con-



jecture. From October to March gorse will be found as useful an adjunct to the dairy farmers' commissariat as could be desired, but as the plant comes into flower its use for feeding should be discontinued. The young shoots of the wild furze will pay for cutting, bruising, and mixing with hay, straw, or roots, as food for dairy cows, whilst in the case of the cultivated plant nearly the whole shrub may be utilized as food. It was owing to its prickles that furze was so long ignored as a forage plant, and although it might seem a comparatively easy task to pound them so that they should not wound the mouths of cattle, many practical difficulties presented themselves. These, however, have all been overcome in the gorse masticator of Messrs. M'Kenzie & Sons, Cork, the price of which ranges from about fourteen guineas upwards. The late Mr. John Algernon Clarke, in describing it in the course of his report upon the Kilburn Show, 1879, said :—" By this most effective machine, furze, gorse, or whin, as it is variously called, no matter how stubborn it may be, is rendered soft, and the prickles are broken, so as to be innocuous to cattle and horses. This machine is now able to accomplish what has never been done before, for it will prepare as a valuable food, not only the succulent shoots of furze sown and cut every year, but the furze growing in a wild state; and this is found to be of high value as a fodder, while its cost is exceedingly small." The subjoined table is given as showing the relative nutritive capacity of gorse and other green foods, the figures being percentages :—

	Flesh-formers.	Fat-formers and heat-producers.
Furze . . . . .	3.21	9.38
Kohl-rabi . . . . .	2.75	8.62
Swedes . . . . .	1.94	5.93
Turnips . . . . .	1.80	4.43
Cabbage . . . . .	1.63	5.00
Mangel . . . . .	1.54	3.60
Carrots . . . . .	0.60	10.18

*Fir-tops*, or the young and tender shoots of fir-trees, have likewise been employed with effect in cases of emergency, as a substitute for other articles. A correspondent states, that, being in great want of provender, and having scarcely any hay, he was compelled to feed his beasts on fir-tops, and though he had more than two hundred head of neat cattle, he did not lose more than *four or five* out of that number; while many graziers, farmers, and breeders lost one-half, and several of them nearly the whole of their live stock.

Straw of the cereals and of beans has been much written about, as a feeding material for cattle.

"The composition of the straw of the cereals," as we have elsewhere remarked, "is very similar in all. Yielding a large percentage of woody fibre, and but a small one of flesh-formers, straw possesses but a low nutritive value. But this is not precisely the way to judge the question: the important matter of bulk must not be overlooked. This is, indeed, essential, for without it health would not be maintained; hence the value of the straws, when used in conjunction with food

richer in flesh-formers and heat-givers. As regards oat straw, it is worthy of note, that when cut green—the ear, however, being fully formed—it is highly valued as a feeding material, its value being increased one-fourth. When used, it should be cut into half-inch lengths.” “Oat hay,” says Dr. Voelcker, “or oats cut green, contain a large proportion of soluble substances, readily digestible, but which become insoluble, and less readily digestible, when allowed to ripen. Animals fed upon young shoots of vegetables, which are soft and eatable, thrive well, but can scarcely maintain themselves upon matured food, which becomes woody and indigestible, and passes through the intestines in a great measure unchanged. The reason of this difference is, that the starch, gum, sugar, and other soluble and readily digestible substances which we find in the young shoots of vegetables and roots, are partly rendered insoluble, and gradually changed into indigestible woody fibre, which substance increases with the age of the plant.”

The straws of beans and peas are more valuable as feeding-stuffs than the straws of the cereals; cut into short lengths, and mixed with the chaff of cereal straw, they add value to the latter.

Dr. Voelcker thoroughly investigated the subject of the feeding-value of straws as compared with hay, and published a number of analyses of the various straws.

It appears from these analyses :—

1. That hay, especially clover hay, is much richer in albuminous or flesh-forming compounds, than straw.
2. That it contains also more oil and fatty matters.
3. That both clover and meadow hay, when well made, are much richer in sugar, and other soluble matters, than straw. Good meadow hay, especially, contains a great deal of sugar, and is sweet to the taste.
4. That the proportion of indigestible woody fibre, particularly in meadow hay, is much smaller than in straw; and
5. That good meadow hay contains more digestible fibre than clover hay.

For these reasons, both clover and meadow hay are, as feeding substances, superior to straw.

The kinds of straw, that approach in composition the nearest to hay, are green oat straw and pea-haulm.

It has been stated already that the degree of maturity in which straw is harvested materially affects its composition and feeding value; likewise, that probably the climate and character of the land have great influence in producing the most nutritious kinds of straw. It is, therefore, impossible to pronounce, in a general way, whether wheat, oat, or barley straw is the most valuable for feeding purposes. Assuming, however, the land and climate to be equally well adapted for producing the best kind of straw in each case, and the crops to have been harvested in the same stage of maturity, Dr. Voelcker was inclined to place the different kinds of straw in the following order, beginning with the most nutritious, and ending with the least valuable for feeding purposes :—

1. Pea-haulm.
2. Oat straw.
3. Bean straw, with the pods.
4. Barley straw.
5. Wheat straw.
6. Bean straw, without the pods.

The refuse of the cereals, as bran and malt-dust, or combs, is highly valuable for feeding purposes; both bran and malt-dust are used by Mr. Horsfall in his well-known system of feeding dairy cows.

Dr. Anderson closely investigated the subject of the feeding value of straws, and showed that the value is much higher than has been generally supposed. There can be no doubt at all events that the using it as litter, merely that is as bedding in stalls, or to be trampled under foot in courts, is not the most economical way to consume straw, and Dr. Anderson did good service to agriculture in pointing out how straws can best be used. After giving analyses of straws, this eminent authority states:—

“Passing from these points to the more general considerations regarding the nutritive properties of straw, it must be observed that their value is much higher than might have been expected. The position in which they stand may be best rendered obvious by a comparison with the turnip. That root contains on the average from 1·2 to 1·4 per cent. of albuminous compounds, and 4 or 5 of respiratory elements, of which 3 or 4 are soluble in water. It will be observed then, that, as far as nutritive matters are concerned, straws generally stand far above the turnip, surpassing it slightly in the albuminous, and enormously in the respiratory, elements. As a source of these elements they must hold a very high position, and in this respect are surpassed only by the grains and some few other substances. When compared with roots and grains, however, a very marked difference may be observed between the relative proportions of these two great classes of nutritive elements. The ratio of the albuminous to the respiratory compounds is, in the turnip, as 1 to 3 in round numbers, and in the grains as 1 to 7—that is to say, for every pound of albuminous compounds contained in a grain, as wheat for example, there will be about 7 pounds of respiratory compounds. In the straws the proportions are very different, the total respiratory compounds being never less than 10, and sometimes nearly 30 times as abundant as the albuminous. If the soluble portion of these substances only be considered, then the ratio approaches nearer to that observed in the more concentrated foods, though on the whole the excess of respiratory elements is very marked.

“Returning now to the comparison between the turnip and straws, it is obvious that though the latter greatly exceed the former in the amount of substances which *may* be absorbed, no one would for a moment think of asserting that straws are therefore of greater nutritive value. The reverse is undoubtedly the case, and the cause of this is to be found in several considerations. 1st, It must be attributed in

part to the unsuitable proportion of those classes of nutritive substances; for if highly nutritive substances, such as the turnip and grains, contain a relatively much larger proportion of albuminous compounds, then it may be expected that in the straw the small quantity of these substances will cause the assimilation of only a proportionate quantity of the respiratory elements, and the surplus will be wasted. Hence, also, the use of highly-nitrogenous foods, such as oil-cake and bean-meal, along with straw, must be considered good practice. 2nd, It may be fairly anticipated that the insoluble portion of the nutritive matter will in general be of little, or possibly sometimes of no, use. 3rd, Owing to the difficulty with which the soluble matters pass into solution in water, a considerable part of them may escape digestion. And in this respect, the contrast between straw and turnip is very marked. In the latter, the larger proportion of the constituents are not only *soluble*, but already *dissolved* in the 90 per cent. of water present; but in the former they are not dissolved, but are in the solid state in the dry straw, and must undergo the process of solution, which is effected during mastication and rumination. The difficulty of dissolving the soluble matters of straw in cold water has been already adverted to, and even when warm water is used the process is slow, and requires considerable time. From this it may be concluded that straw ought to be well moistened and steamed before being used. 4th, The large proportion of woody fibre existing in all straws must interfere materially with the production of the full effect of the nutritive ingredients.

“Notwithstanding these drawbacks, the general conclusion to be drawn from this inquiry is that straw, and more especially oat straw, possesses a very considerable nutritive value, but that it is most advantageously used along with the more highly nitrogenised foods. It must be observed, also, that, in a mechanical point of view, it may even have its uses in the intestines, and by giving bulk and firmness to the mass of food contained in them, assist the process of digestion and absorption.”

The use of straw as a feeding substance for live stock has largely increased since the issue of the last edition of this work, and with results at once economical and beneficial. Given in its natural form, or long condition, the lowest results are, as may be supposed, obtained, for not only is much of the straw wasted by being trampled under foot by the animals, but it is presented to them in the least convenient form, so to say, and certainly in that which is far from being the most palatable. To overcome the dislike which some cattle have for it, and the difficulty which all display at first eating it, the practice of cutting the straw into “chaff” or “chop” as it is called, or short lengths by the straw-cutting machine, has been of late introduced. This, although better liked—and less wasted—by the animals, cannot at the best be said to be a “toothsome” or tempting article of food; and there is a difficulty to get some animals to take to it at all—kindly they never do. To overcome the difficulty, the chaff is mixed with other and more palatable feeding stuffs, as meal, ground oil-cake, crushed

grain, bruised oats, beans, &c. But even in this state, while the food may be, and is, taken by the animals, it is easy to see that it is not taken with that readiness which betokens a keen relish. If moistened with water the ingredients are better liked, still more so if salt be added to them. But it is when fermentation is allowed to set in, that the relish we have referred to displays itself. It is not known to whom agriculture owes the introduction of this new method of treating food—the fate apparently of all things nearly connected with the art—but, judiciously availed of, it promises to create quite a revolution in the practice of feeding with foods in which straw is made to form a principal ingredient. Many indeed can scarcely fail to have noticed with what eagerness pigs devour food which has gone sour, or in which fermentation has proceeded to an advanced stage. This may have given rise to thoughts connected with the application of food in a like condition for stock; we ourselves applied it years ago with decided success.

But the mere fermentation of the mixed foods named above is not that alone which decides the economical use; it is the kinds of food which are mixed, and the way in which they are treated, which constitute the feature of the best system. And that system owes its introduction to Mr. Samuel Jonas, of Crishall Grange, Saffron Walden. Briefly described, the system consists in cutting large weights of wheat straw into chaff, placing it in large bins, mixing it with green food cut also by the machine, such as rye or tares, in the proportion of 1 ton of wheat-straw chaff to 1 cwt. of the green food and 1 bushel of salt. When the whole is thoroughly mixed the mass is pressed closely together into the bins, in the early spring months, as soon as the green food is ready to be cut, and allowed to remain till October, when it is begun to be used, its use being continued throughout the winter months. What may be called the chemical result of this process is described by Dr. Voelcker in a very practical paper in the "Royal Agricultural Society's Journal," vol. vii., second series, thus—"The addition of the green stuff causes the straw chaff mixture to heat; the volatile and other flowery principles produced by the fermentation are retained by the straw chaff, itself undergoing a kind of slow cooking process; and they impregnate the whole mass with an extremely pleasant flavour, scarcely inferior to that which characterises well-made meadow hay."

But although the mass, or mess, does possess this flavour, it is not of course equal to hay in nutritive properties. Dr. Voelcker, therefore, recommends some nutritive food, such as ground oil-cake, to be sprinkled among the mass. At the same time it is worthy of remark that there is really not much practical difference between the mass and good hay. The cake used for this purpose should be rich in albuminous compounds. Green German rape-cake or decorticated cotton-cake will bring the mixture up to a relative value as regards those compounds equal to that of good meadow hay. About 2 cwt. of the rich cake ground into meal, added to 1 ton of the mixture, will be found a good proportion. In Dr. Voelcker's paper,

analyses are given of the mixtures, and of their separate constituents, with several remarks of practical value worthy of being attended to. The opinion of this eminent authority is wholly in favour of the plan introduced by Mr. Jonas, and he expresses the hope that that plan will be used "throughout the length and breadth of the land." As we have already stated, much can be done by the farmer in making the most of the materials he has at command by judicious mixing.

The system known as "Ensilage," adapted and improved from methods stretching back into dim antiquity in Eastern and Southern Europe, is the latest development in the economy of live-stock management in this country. It consists in storing grass and other green food, in its succulent state, in silos, pits, or stacks, under powerful pressure, to the exclusion of the atmosphere. The system has received a great deal of attention in recent years, not only because it is an alternative to hay-making in wet seasons, but on account of its alleged intrinsic merits. It is to be feared, however, that certain claims have been advanced which cannot well be substantiated,—for instance, that well-made silage is superior to the grass or other green food from which it is made, and that rank, inferior grasses, and even various plants—spurrey, for example—which in an agricultural sense are regarded as weeds, are greatly improved and converted into good food in a silo. Admitting that good silage is a good winter food for stock, when used in moderation, and chiefly because it remains in a soft and easily-digestible condition, it must be borne in mind that both skill and care are required to make the system a success. Those who wish to study the subject may consult Mr. George Fry's book on "Sweet Ensilage," and the Ensilage Society's publications (*see*, too, page 842).

The "Live Stock Journal" published a series of reports from representative men embodying some account of their practice, not so much as regards animals intended for show purposes, but rather with reference to the breeding, feeding, and management of cattle of the choicer sorts intended for the butcher. This appears to be an appropriate stage at which to give extracts from some of these, and we select for the purpose the opinions of reliable representatives of half a dozen different counties.

Mr. Richard Stratton, The Duffryn, Newport, Monmouthshire, says: "As my business is chiefly Shorthorn breeding and bull selling, combined with a large milk trade, I do not make beef to any very large extent, but usually make steers of bad coloured or inferior bull-calves, and occasionally I buy whatever I think likely to pay most money, without regard to breed. In the case of my own bull-calves, they are usually kept on the cow a month or so, then weaned on skim-milk, and occasionally with the help of calf meal, kept in a nice growing, healthy state, with a little cake or meal, green food, or hay according to the season, for one year: then good grass for six months, again with cake, roots, &c., to finish off at two years old, when they would weigh about forty scores—800 lb. I would prefer to have a calf in February or March. Keep it in during the first summer, eating cut grass, &c.; out next summer on good grass, roots, straw, and 4 lb. cake. During the

second winter 4 lb. cake ; on grass the following summer, and fat for butcher at two years and six months at about forty-eight scores, and so have three summers and two winters ; but all these details depend upon circumstances, nature of occupation, whether chiefly arable or pasture, whether you sell straw or consume it. I have to study economy of winter keep, and want to hold a heavy stock in summer and as light a one as possible in winter. I use any kind of feeding stuff that may be cheapest, perhaps more decorticated cotton cake and maize meal than anything else."

Mr. Charles Howard, Biddenham, Bedford, reported: "In my case, I have grass land adapted for grazing and rearing store cattle. I fat upon grass, with the aid of a little linseed and cotton cake mixed, about 3 lb. or 4 lb., some forty to fifty head. Those not quite up to the mark at the end of the grass season are put into yards or stalls, and finished off for Christmas markets with hay and hay chaff, a few roots, and some 7 or 8 lb. of cake, and a peck of barley and bean-meal mixed, per day. Before I bred Shorthorns I generally bought Herefords, and as I have a strong liking still for that breed, particularly for our second-rate pasture land, I graze a few every year. They are splendid yard beasts, being so docile and quiet. They do not drive each other about, but fill their bellies and quietly lie down to rest. I find, too, on our pastures, they fat quicker, and are ready for market in the month of July, at which time they command a ready sale in the London markets. My Shorthorn bullocks, which grow as well as fat, do not come to market quite so early. Besides a few thoroughbreds, I have a herd of well-bred dairy Shorthorns, by thoroughbred bulls, about thirty in all, partly to supply Bedford with milk, to wean calves, and for dairying purposes. I wean, with those I buy, some fifty a year. The pure Shorthorns I treat more generously, but the ordinary calves have new milk, about a gallon a day, for six or eight weeks, and are then put upon skim-milk, with gruel made from linseed cake and a little wheat or barley flour for about the same time ; they are then fed upon hay and mixed chaff, with pulped roots or cabbages, and a little linseed cake and meal. I never use cotton cake for calves, as I find it too astringent. They are not turned out to grass until they are nine or ten months old, and then are a little bit nursed in yards either in the day or night, according to the heat of the weather. The yearlings and two-year-olds graze with sheep the somewhat inferior pastures. In the winter most of them run the pastures for a few hours, and at night are put in yards, where they get a supply of cavings, hay and straw chaff, with a little cake or meal, according to circumstances. With regard to the fattening bullocks, I would state that the Herefords are three years old, or perhaps a little more, and generally reach from 54 to 56 stone (14 lb.). My Shorthorns are mostly disposed of at three years old or thereabouts, and reach from 58 to 60 stone. Those I keep over for the Christmas market are 3½ years old, and they reach 68 stone and upwards."

Mr. Robert Wortley, Suffield, Norfolk, states: "Our custom in Norfolk is, where we have little or no pasture, to buy our cattle in the

autumn for winter feeding on roots. The ordinary way is, after the cattle have been home a week or two, and put in the old or new layers, common turnips are given them there. They are then put into what we call yards; some have boxes. They are given an unlimited supply of roots all through the winter. Some people expend up to £5 worth of artificial food for each animal; others give but little. My custom is to buy my cattle in the autumn for winter feeding. Since the price of meat has fallen, I buy young cattle from £8 to £14 each. I commence selling in March and finish in June, and generally make my cattle leave £10 per head for feeding; they will each eat from £2 to £5 worth of artificial food, principally cake, sometimes of corn grown on the farm mixed with maize and lentils ground together. The more artificial food I consume the greater number of cattle I feed, but that depends on the prospect of getting a return. If I can buy them in fairly cheaply I buy a larger quantity, and use more artificial food. Whereas, if the store cattle are dear, I buy less and use less artificial food. This is not always a safe plan, although often adopted."

Mr. John Hill, Felhampton Court, Church Stretton, Shropshire, writes: "First and foremost, let whatever class of animal you feed be of the best quality, and such as will respond at once to any liberal feeding spent upon it. Next, all feeding should be progressive; if the animals are bred on the farm, the calf should never be allowed to fall back in condition from the day of its birth to the day of its slaughter as a butcher's beast. If the animal is purchased, it all depends upon its condition, and its previous treatment, as to how you should proceed; if it is low in condition, on no account begin too quickly to cram it with artificial food, but commence with about 2 lb. of mixed meal and cake per day, and gradually increase it, or the cattle will over-eat themselves at first, which will cause surfeit and humour, and take weeks to regain a healthy appetite. With regard to whether it is best to breed or purchase stock for feeding, it depends upon your land and surroundings, but I believe in almost every case it pays best to breed, unless your farm is within easy reach of some of the great markets, where large droves of young cattle are collected by the dealers, who pick them up from the small farmers and cottagers at a very cheap rate. This class of stock, usually bred from Shorthorn milking cows, are invariably low in condition, having been reared on skim-milk, and therefore more suited to carry on quietly than to make quick returns. These animals, having lost their calf flesh, take some time before they start to grow, and must not be overdone at first. On the other hand, calves that are bred on the farm intended for the butcher should be pushed on from birth. As is the usual practice among Hereford breeders, my calves run with their mothers until about six or seven months old, getting about 1 lb. of cake or meal when sucking, and this amount is gradually increased up to 3, 6, 8, 14, or even 20 lb. a day, according to the age and the purpose the animal is required for. The only chance for farmers now is always to have plenty of well-bred stock on hand, and in such condition that the best advantage can be taken of the markets. Good-bred animals of the best quality eat less



and fatten quicker than badly-bred ones, and therefore are the most economical."

On the farm of Mr. T. S. Minton, Montford, Shropshire, the breed of cattle is the Hereford. "The calves are dropped in January, or as soon after as possible. The calves are generally left in the open yards, and the cows go on the pastures during the day, receiving a few roots in the day and barley straw in yards at night; the calves a little hay and cake and meal. In May cows and calves are turned out together on the grass, where they remain until September or beginning of October, when they are weaned, the calves being housed at night and receiving  $1\frac{1}{2}$  lb. of cake and meal and hay, and out on grass in the day. As soon as the roots are ready, beginning of November, they have two small feeds, one in the morning after their corn, and another at night. They are allowed to go out in the day as long as the weather is fine, after which they are kept in warm, open yards, entirely receiving hay, three feeds of roots, and 2 lb. of cake and meal. The following May the steers are turned out on the best grass land, where they remain until September, when we commence giving them 3 lb. of cake. During October they are got into the yards, receiving three feeds of cut roots, 5 lb. of cake and meal, and barley straw. In March they are good beasts, and should be 9 score per quarter, which, when at 8*d.* per lb., shows a fair return—£24. I think the great secret, both in cattle and sheep, is to keep them in a healthy, thriving state from birth till fat, not to over-corn, but a judicious allowance with plenty of natural food, and never let your animal have a check."

Mr. John Cridlan, Great Malvern, Worcestershire, states: "In the first place I consider housing of the utmost importance. Large, roomy boxes should be provided, that admit of the animals moving about at pleasure; stalls and small cramped boxes should be studiously avoided. The size of mine, for the heavier and older beasts, is about 26 feet long and 10 feet wide, facing due south—light and air being a desideratum; for the yearlings and two-year-olds small boxes are provided. Secondly—Food: This should be of the best quality, and varied in character; peas, beans, maize in small quantities, oats, barley, and sometimes (lately) a little wheat passed twice through the crushing-machine. This I find preferable to meal, although at times I use it for a change. The beasts seem to handle better and firmer than when fed on meal and cake solely. It is a most singular thing that I can never get my show cattle to eat linseed-cake; I have spared no expense to obtain the best, but to no purpose; they one and all 'blow' on it and leave it. Thirdly and lastly—though not the least important—Exercise. Each animal should be led, and every morning walked about very gently and at its own pace. Mine are then stood in a running 'foot-bath,' viz., a stream of pure water from the springs in our far-famed Malvern Hills, which passes through the farm on its way to the Severn; the consequence being I never had an animal bad on its feet."

The experience of Mr. Edwin Ellis, Summersbury, Guildford, Surrey, is both interesting and instructive:—

"I buy the best Shorthorn calves I can get. The dealers in this neighbourhood who collect calves from the West of England know when they have got a 'clipper' where to take it, and they naturally require a high price for such. But he must be a good one—long, broad over the loins, with a deep chest and full eye—then if he is a dark roan, or red, and has a clean 'sweet' muzzle, he is appreciated.

"I have tried Herefords, and can find no objection whatever to them. They will come to maturity just as quickly; and if I had as large a number of Hereford calves to choose from as of Shorthorns I should often take them, although I must confess to a secret leaning to the graceful 'red, white, and roan.' I use no 'calf-food,' so called. The calves are 'pailed' at once with new milk; sometimes diluted if we are short, in which case a little linseed-cake dust is stirred in. They learn to chew a piece of sweet meadow hay very soon, and lick a little oatmeal, and shortly after amuse themselves by chewing some sliced roots, which must never on any account be touched by frost. They are always kept warm and in good condition. The losses are very few, although I have in some years suffered by scour, arising doubtless from change of food of the cows. During the present year we have had no losses from this cause.

"Calves weaned after June never leave the stalls and boxes till they go, as bullocks, to the butcher. Those weaned early in the year run in the paddocks all the summer, being carefully housed at night and always having shelter from the rain or the heat of the sun. Under no circumstances are they ever allowed to get into low condition; their diet is varied according to seasons and the crops grown. I have no hard-and-fast rule of feeding, as I think it should be so elastic as to accommodate itself to the farm produce of the day. From May to October, when my stalls are generally quite full, green food of all descriptions is brought to the cattle. The cost of labour is a consideration, but must be borne. Trifolium, spring cabbage, tares (early and late), and then, again, autumn cabbage and aftermath of clover make admirable feeding. The consumption of straw for litter in the summer months is very slight. Bullocks do well on the bare floor, with a few hedge-trimmings or other rubbish. No calves of mine are ever allowed cotton-cake; always the best linseed, from which the oil is not all pressed out by the last new invention. I feed with good sweet barley straw in preference to secondary hay, oatmeal, barley-meal, and last season, when the root crop on my farm was a perfect failure, fed treacle, with chopped hay and straw, and without any roots whatever. My bullocks never came on quicker or better, teaching me plainly that 'better no roots than too many.'

"My experience has taught me that all animals intended for early maturity must be kept gradually going on, and that this is the most economical system of fattening. I have often turned out bullocks under two years weighing their 120 stone, that never *would* eat over 3½ lb. of cake per day, although, of course, they had meal as well. But, contrast this with the consumption of some of the raw-boned three-year-old Irish steers, which on one or two occasions I have bought to

fill up with. Their constant cry is 'Give! give!' and like the grave, they never return what is given. For two months they seem to do nothing but eat, and at the end of even that time the skin sticks hard to their ribs. Then you finish off with two bushels of roots, hay *ad libitum*, corn and cake up to six, or even eight pounds per day, and the feeder must put a very high value on his manure to convince himself he has had a good investment.

"I have found that ten bullocks of this latter character consume more food than twenty young steers in good condition at sixteen months old. It is a very difficult thing to estimate the exact cost of bringing up a calf to the ripe maturity of sixteen or eighteen months, and any estimate must be more or less vulnerable; but what I have always tried to do is to make every man who looks after my stock, of whatever character, an enthusiast in his work. When that is accomplished, your feeding will be satisfactory, and not till then.

"I find the old-fashioned corn-barns very useful for my growing stock. A good 'bay' will carry a dozen young things all the winter. They have plenty of air and exercise, and the dung is first class. I generally have about twenty bullocks on the chains, and keep them filled from the bays, picking out the best steers as required. The young beasts (of the Shorthorn breed) do quite as well in bays as when tied up, but if there should be a bad-tempered one amongst them, the sooner he is got out the better.

"One great advantage of my system appears to be this: whether the bullocks are twelve months old or sixteen months they are always 'beef.' We can therefore suit ourselves as to when they go to market. If trade is bad we slacken, and sometimes hold over for two months, and then with markets better out they go. The greater number go out between May and October; then we generally wait till Christmas, and in January especially find a demand for a small ripe bullock. But as a rule they pay better in the summer months, when nice small joints of the primest quality are wanted by the Brighton and other butchers who attend our local markets. My bullocks generally weigh from 65 to 90 stone, according to demand (consequently age). They fetch top prices on the market, buyers knowing by experience that they 'die well.'"

Earlier maturity of live stock is the goal at which breeders have for years been aiming, and in proportion as they have been successful in their efforts, so have they advanced in the direction of early fattening. The latter reduces time and labour, and lessens risks, for if a bullock can be turned out in a ripe condition for the butcher a year, or two years, earlier than was formerly the case, the cost of merely maintaining the life of the animal—no trivial item, by the way—is greatly curtailed. Mr. John Coleman, in the columns of the "Field," clearly indicated the conditions and requirements:—

"First and foremost, a tendency to early maturity, rendered hereditary by cultivation. Secondly, abundance of good natural food; our land must be in high condition, the pastures composed of nutritious grasses, and the crops we grow of the best possible quality: poor,

stunted crops will not bring on young animals; and especially must we have plenty of lime and phosphates in the soil for the development of bone and muscle. Then the climate must be temperate, although this is of less importance than the other factors we have named, because much can be done in the way of shelter. Lastly, the judicious use of artificial food to supplement the natural produce.

“Now let us consider the treatment of calves on a dairy farm; and the management we indicate is such as we have seen carried out with most successful results. The calves are dropped in the spring—probably in March, on the average—and are removed at birth, and not allowed to suck the cow. For a few days their food consists of new milk; after about ten days or a fortnight, warm skim-milk is introduced, with calf-meal, boiled linseed, &c., and by degrees the new milk is entirely replaced by old milk, and such easily digested nutritious materials as experience shows to answer. When the calf is one month old, a little sweet green hay is supplied, with rock salt and chalk. As the spring comes on, there are two plans open to us—we may either keep them in well-ventilated covered yards, supplying a mixture of green and dry food, which has some advantages, especially in the selection and preparation of suitable food, and protection from irritation by insects, from which serious loss of condition often occurs; or they may be turned out during the day into a home paddock, being brought in at night. In either case, they should still have any skim-milk we can spare, in which ground linseed cake or linseed meal may be soaked, and a small quantity of pulped mangel, with carefully-prepared chaff (principally made from hay and a little oat straw) and a little oatmeal, may also be used; indeed, the greater the mixture of nourishing material, the better. It is not the quantity of food that will be consumed, but the quality, as developing frame and flesh, that is important.”

The following appeared in the “Live Stock Journal,” 24th January, 1908:—

#### “A COMPARISON OF SMITHFIELD SHOW CARCASSES.

“The information obtained by the ‘Live Stock Journal’ from the purchasers of cattle exhibited at the Smithfield Show, in respect to carcass weight of the animals, &c., affords opportunity to make some interesting comparisons with similar stock exhibited in the classes for carcass competition at the same show. In the calculations made for use in the comparisons referred to below the Highland oxen, &c., over three years of age, and the cross-bred heifers not exceeding two years, which were included in the butchers’ reports, have not been taken into consideration, as there were none of the corresponding character included in the carcass competition.

The class for steers not exceeding two years of age in the carcass competition secured an entry of ten present, the aggregate age amounting to 6,640 days, giving the aggregate live weight of 12,684 lb., and a carcass weight of 8,252 lb., the percentage of carcass to live weight working out at 65·05 per cent., and the average daily gain alive 1 lb.

14·56 oz., and the carcass of 1 lb. 3·88 oz. The butchers' reports included nine of this age, whose aggregate age was 6,006 days, showing a gross live weight of 12,063 lb., and a carcass weight of 7,822 lb. The percentage of carcass weight was 64·84, the average daily gain alive 2 lb. 0·19 oz., and the average daily gain of carcass weight 1 lb. 4·63 oz.

"Comparing these two lots one observes that those animals sent for exhibition alive give a larger average daily gain both alive and in the carcass, but the others in the carcass class show the larger percentage of carcass to live weight. The highest percentage of carcass to live weight in the butchers' reports of this age was 71·81 for the *he* Short-horn steer No. 60; the corresponding position in the carcass class was occupied by an Aberdeen-Angus, No. 597, which won first and champion honours, 67·81 per cent. In the butchers' reports the second prize Hereford, No. 38, gave the highest average daily gain both alive and in the carcass, 2 lb. 8·14 oz., and 1 lb. 10·06 oz. This position in the carcass class was by the South Devon, No. 591, fourth in its class, the average daily gain of which was 2 lb. 11·35 oz. alive, and 1 lb. 11·18 oz. in the carcass.

"The summarised comparison of this result is that, taken as a whole, the animals exhibited alive show a higher average daily gain both of live weight and carcass weight, with a slightly less percentage of carcass to live weight.

"The older steer class in the carcass competition numbered a dozen, which gave the aggregate weight of 16,705 lb. alive, and 10,848 lb. in the carcass, at the aggregate age of 11,310 days. These data show that the percentage of carcass to live weight was 64·77 per cent., the average daily gain alive 1 lb. 7·67 oz., and in the carcass 15·34 oz. The butchers' reports are very full, for particulars are given of thirty-three steers, the aggregate age of which was 34,045 days, with a gross live weight of 54,916 lb. alive, and 35,690 lb. in the carcass, from which it is found that the percentage of carcass to live weight was 64·93 per cent., the average daily gain alive 1 lb. 9·33 oz., and the average daily gain of carcass weight 1 lb. 0·77 oz.

"The comparison of the aggregates of these two lots shows, as mentioned in connection with the younger steer, that the animals specially prepared for exhibition alive gave the larger daily gain both before and after slaughter, but that with the increased age the best percentage of carcass to live weight by the more heavily fed animal. It is interesting, however, to note that whilst the younger class shows an average daily gain of carcass weight of 1 lb. 4·63 oz., and 1 lb. 3·88 oz. respectively for the two sections of the show, the older class only gives 1 lb. 0·77 oz. and 15·34 oz., proving how much more profitable it must be to finish off the animal at the younger age. The third prize Sussex steer gave the highest percentage of carcass to live weight in the butchers' reports, 70·67 per cent., and in the carcass class this place was filled by the fourth prize carcass, No. 604, with a percentage of 66·31 of carcass to live weight. The best daily gain alive in the butchers' reports was 2 lb. 1·05 oz. for the third prize Hereford, No. 40, two others giving 2 lb. or

over, *i.e.*, No. 177, a Welsh steer, 2 lb. 0·21 oz., and No. 66, a Shorthorn, first and third cup winner, 2 lb. The best daily gain in the carcass classes alive was, as in the young steer class, made by a South Devon, No. 601, 2 lb. 2·43 oz. The best average daily gain of carcass weight was for the butchers' reports 1 lb. 6·56 oz., given by the Hereford steer, No. 40, being closely followed by the Shorthorn steer, No. 66, whose carcass weight worked out at 1 lb. 6·04 oz. per day. In the carcass class the South Devon, No. 601, was clear ahead of all competitors. Its average daily gain of carcass weight came out at 1 lb. 5·98 oz., the nearest approach to which was 1 lb. 1·41 oz. given by a Galloway steer, No. 610.

"Eleven heifers under three years of age made up this class in the carcass competition, the aggregate age of which was 9,587 days, giving an aggregate weight of 13,094 lb. alive, and 8,436 lb. in the carcass, from which it is ascertained that the percentage of carcass to live weight was 64·42 per cent., the average daily gain alive 1 lb. 5·85 oz., and 14·07 oz. in the carcass. The butchers' returns give particulars of twenty heifers, the aggregate age of which was 19,603 days, showing a live weight of 27,601 lb., with a carcass weight of 18,666 lb., which equals a percentage of 67·62 per cent. of carcass weight to live weight. The average daily gain alive was 1 lb. 6·50 oz., and carcass daily gain 15·22 oz.

"Compared with the corresponding class in the carcass competition in each of the particulars referred to in the previous sentence the advantage was with those animals which were not fed expressly for slaughter, and the information given by this comparison indicates that these animals showed that just 3 per cent. of their carcass weight over live weight, about one ounce of the daily gain alive and also in the carcass was in excess of those animals fed expressly for the carcass competition. The highest percentage of carcass weight in the butchers' reports was 71·14 for the first prize Dexter, No. 261, and in the carcass class 68·19 for the third prize Galloway Aberdeen-Angus cross No. 619. The best daily gains in the butchers' reports were alive 1 lb. 11·23 for the Red Poll second prize, No. 112, and in the carcass 1 lb. 3·70 oz. for the cross-bred Polled, No. 241. The corresponding figures for the carcass competition were both given by the Shorthorn Aberdeen-Angus cross, No. 621, and were as follows: 1 lb. 14·92 oz. alive, and 1 lb. 1·47 oz. in the carcass."

The following is an abridged table giving the results returned by butchers who purchased some of the live cattle from the Smithfield Club Show of 1907, referred to in the article quoted above. We are not able to find space for a reproduction of the tabulated results of the Carcass Competition with which the butchers' returns are compared. We give also the corresponding table for some of the sheep purchased from the classes of live animals:—

CATTLE SLAUGHTERED FROM THE SMITHFIELD CLUB SHOW OF 1907.

No. in Catalogue.	Description of Animal.	Honours.	Age.	Live weight.	Average daily gain of live weight.	Weight of dressed carcass.	Percentage of carcass to gross live weight.	Weight of hide.	Weight of loose fat.
<i>Steers not Exceeding Two Years Old.</i>									
38	{ James Edwards' Hereford steer (Twyford Block Test)	Second	Days.	lb.	lb.	lb.		lb.	lb.
60	{ Sir Oswald Mosley's Short-horn steer	h.c.	671	1,687	2.51	1,098	65.08	87	106
81	{ John Aungier's Sussex steer	c.	635	1,295	2.03	930	71.81	48	72
139	{ Alfred Palmer's Galloway steer	e.	642	1,472	2.29	976	66.30	60	96
273	{ R. W. Hudson's cross-bred steer—s Aberdeen-Angus d. Dexter (Danesfield Sweet William)	First	626	1,147	1.83	760	66.26	70	75
<i>Steers above Two and not Exceeding Three Years Old.</i>									
14	J. C. Williams' Devon steer	...	979	1,413	1.44	986	69.78	...	...
23	{ Peter Dunn's Shorthorn steer (Gentleman John)	Champion	993	1,835	1.84	1,176	64.08	...	...
42	{ Sir J. R. Cotterell's Hereford steer	First and breed cup }	938	1,944	2.06	1,334	68.62	...	115
49	{ Richard Bright's Hereford steer (Ben)	h.c.	1,024	1,830	1.78	1,190	65.02	...	...
61	{ His Majesty the King's Shorthorn steer	Third	1,005	1,820	1.81	1,202	66.04	108	93
66	{ Sir Oswald Mosley's Short-horn steer	First & breed cup, also cup as best ox or steer	1,011	2,032	2.00	1,400	68.89	...	101
89	Stephen Agate's Sussex steer	Third	1,068	2,012	1.88	1,422	70.67	132	124
122	{ J. J. Cridlan's Aberdeen-Angus steer (Black Chief)	...	1,078	1,820	1.68	1,222	67.14	74	...
144	{ Alfred Palmer's Galloway steer (Dick)	Third	1,026	1,526	1.48	1,026	67.23	62	92
<i>Heifers above Two and not Exceeding Three Years Old.</i>									
21	{ His Majesty the King's Devon heifer (Carolina)	r.	1,051	1,275	1.21	866	67.92	...	...
22	{ T. S. Morgan's Devon heifer (Ruby)	Second	970	1,479	1.52	976	65.99	75	78
50	{ His Majesty the King's Hereford heifer (Prudence)	First	1,074	1,657	1.54	1,191	71.87	...	68
17	{ P. F. R. Saillard's Sussex heifer (Bewbush Evelyn)	First and r. } for breed cup }	1,056	1,744	1.65	1,238	70.98	72	79
183	{ The Hon. F. G. Wynn's Welsh heifer (Merch Megan)	h.c.	913	1,472	1.61	996	67.66	67	91
209	{ His Majesty the King's Highland heifer	r. and h.c.	1,275	1,398	1.09	878	62.80	...	...
241	{ The Duke of Richmond and Gordon's cross-bred heifer	c.	1,081	1,767	1.63	1,236	69.94	76	85
243	{ Miss Alice de Rothschild's cross-bred heifer—s. Shorthorn, d. Aberdeen-Angus (Waddesdon Sylvio)	First	1,038	1,703	1.64	1,176	69.95	82	76
261	{ R. W. Hudson's Dexter heifer (Danesfield Marjorie)	First and breed cup }	967	894	0.92	636	71.14	...	56

SHEEP SLAUGHTERED FROM THE SMITHFIELD CLUB SHOW OF 1907.

No. in Catalogue.	Description of Animal.	Honours.	Age.	Average live weight.	Average daily gain of live weight.	Average weight of dressed carcass.	Average Percentage of carcass to gross live weight	Average weight of loose fat.
			Days.	lb.	lb.	lb.		lb.
<i>Wether Lambs under Twelve Months Old.</i>								
319	John McDowall's Mountain lambs	...	240	110	0.45	60	54.54	...
347	Samuel Barrow's Southdown lambs	...	300	152	0.50	90	59.21	81
350	F. H. Jennings' Southdown lambs	...	277	139	0.50	82	58.99	...
355	James Toop's Southdown lambs	c.	284	159	0.56	98	61.63	...
376	{The Exors. of the late Sir W. G. Pearce's Hampshire lambs	...	309	216	0.69	134	62.13	13
379	Samuel Darling's Hampshire lambs	c.	314	204	0.64	133	65.19	14
389	D. Abbott Green's Suffolk lambs	r. and h.c.	284	193	0.67	122	63.21	8
399	Lady de Rothschild's Shropshire lambs	Second	284	166	0.58	100	60.24	10
411	W. H. Lovall's Oxfordshire lambs	...	300	222	0.74	136	61.21	12
425	James Toop's cross-bred lambs—Dorset and Southdown	Second	291	201	0.69	121	60.19	...
431	{John McDowall's cross-bred lambs—s. Border Leicester, d. Cheviot.	r. and h.c.	240	171	0.71	91	53.21	9
<i>Wether Sheep above Twelve and under Twenty-four Months Old.</i>								
286	Ernest F. Jordan's Leicester wethers	First and breed cup	630	296	0.47	203	68.58	9
287	Ernest F. Jordan's Leicester wethers	Second	630	280	0.44	185	66.42	16
293	S. E. Dean & Sons' Lincoln wethers	First and breed cup	655	375	0.57	228	60.80	...
335	W. Conwy Bell's Welsh wethers.	r. and h.c.	552	135	0.24	82	60.74	...
361	Exors. of the late Col. H. McCalmont's Southdown wethers	First and r. for cup	644	215	0.33	165	76.74	11
362	Exors. of the late Col. H. McCalmont's Southdown wethers	Fourth	630	213	0.33	152	71.36	10½
364	The Duke of Richmond and Gordon's Southdown wethers	c.	614	174	0.23	113	64.94	6½
366	Sir Julius Wernher's Southdown wethers	Second	647	209	0.32	140	66.98	7
394	H. E. Smith's Suffolk wethers	Second	660	271	0.41	172	63.47	12
<i>Wether Sheep above Twenty-four Months Old.</i>								
332	E. Nicholas & Sons' Welsh wethers	Second	1,320	170	0.12	96	56.47	10



The old-fashioned notion was that an animal must have completed its growth before it could be fattened profitably. At the present time, all the improved breeds rival one another in regard to the early period at which they may be fattened. But for this claim, the Sussex cattle would not have emerged from their local obscurity in the depths of the Weald, nor would the Hereford have been found abreast with the Shorthorn upon the ranches of the Far West; while even that broad-backed beef-making bullock the Polled Aberdeen has come to the front as a quick feeder. It will be seen in the tables for cattle and sheep alike that the highest daily gains in live weight are to be found in the younger classes of animals. In percentages of carcass to gross live weight, comparing the two divisions of steers, there is no decided difference; and although in this respect the sheep have an advantage over the lambs, it is to be borne in mind that the former were under two years of age.

As an appropriate conclusion to this chapter we quote from the "North British Agriculturist" the following extract from an article on the preparation of cattle for shows, by that experienced and successful feeder, Mr. Wm. Watson, late of Keillor:—"Feeding at the present date is more an art than a science. There are hosts of undiscovered facts in regard to it which if known and rightly used would redound to the advantage of stockmen. Much can be learned by taking the monthly live-weight of your cattle. If you have had occasion to make a change of feed the scales will prove truthful, and you can learn at once whether that change has been to your advantage or not. Remember the true feeding value of an article of cattle food can be determined only by actual trial, for in the long run there is no chemist like *digestion*.

"In feeding we must all be aware that, as a general rule, farmers make the feeding day too short, consequently the night too long. I mean by that, the animals are only fed *three* times daily—say, at six or seven in the morning, at twelve noon, and between five and six in the evening. Now, cattle to be made the most of—I speak of show cattle especially—ought to be fed *four* times a day, viz., at five A.M., at eleven A.M., at four P.M., and a good hot supper at eight o'clock at night. The ingredients for supper should be the same in substance as those which I am about to detail. The several items should be measured into a pail, adding flax seed and molasses gravy, and over all let there be a handful of finely-cut hay chaff, so as to absorb all steam. Now, pour on boiling water, and cover well with a sack, so as to prevent evaporation and waste. Before feeding, mix the chaff with the mess. Do this about four o'clock in the afternoon, and the mush will be in a nice milkwarm state for feeding by eight at night. The cattle will eat it greedily, and rest till five the following morning. Always put a little sweet hay beside the animal, so that he may eat if he feels so inclined. If you have a number of cattle in training it will be found most convenient to have a large water-tight feed-box for scalding the meals.

"The minute sub-division of food enables the stomach to contain at least 25 per cent. more in quantity than with loose hay or large roots,

so always present your food in the smallest possible compass requiring the least mastication. Every half-hour saved in feeding is so much added to rest—a most important item in fattening. Dry, finely-cut chaff mixed with the meals will prevent laxity and flatulence, producing also a sufficient and healthy excitation to the stomach, while it will afford to the gastric juices a ready access to every part of the mass of food. Cattle lay on a much larger quantity of flesh in comfortable quarters than they do in cold. This is consistent with the well-known fact that the rapid abstraction of heat by a cold atmosphere renders necessary a large quantity of food to keep up the supply of carbon ; but while there is warmth there must be ventilation.

“It may be interesting to my readers to know how closely my system of feeding agrees with the German standards. I present a table giving the average amount of digestible matter in the food used :—

PERCENTAGE BY WEIGHT OF DIGESTIBLE MATTER IN FOODS USED.

Feeding Stuffs.	Protein.	Carbo-hydrates.	Fat.
Oats . . . . .	9·5	44·4	3·9
Wheat . . . . .	9·2	64·9	1·4
Corn . . . . .	8·4	64·9	4·7
Bran . . . . .	12·6	44·1	2·9
Barley . . . . .	9·7	63·2	1·3
Peas and Beans . . . . .	19·7	55·0	1·5
Flax-seed . . . . .	18·9	19·9	32·4
Molasses . . . . .	...	60·0	...
Beets . . . . .	1·2	4·8	...
Chaff—clover . . . . .	6·9	38·5	1·2

“From this table we construct the second, which presents the amount of protein, carbo-hydrates, and fat in the several food articles :—

AMOUNT OF FOOD GIVEN TO A 1200-LB. STEER DAILY.

Feeding Stuffs.	lb.	Protein.	Carbo-hydrates.	Fat.
Oats . . . . .	4	·380	1·78	·156
Wheat . . . . .	4	·368	2·60	·056
Corn . . . . .	4	·336	2·60	·188
Bran . . . . .	4	·504	1·76	·116
Barley . . . . .	4	·388	2·53	·052
Peas and Beans . . . . .	4	·788	2·20	·060
Flax-seed . . . . .	1	·189	·20	·324
Molasses . . . . .	1	...	·60	...
Beets . . . . .	4	·048	·19	...
Chaff . . . . .	4	·276	1·54	·048
Total . . . . .	34	3·277	16·00	1·000

"It will be seen that our 1200-lb. steer consumes daily 3·277 lb. of protein, 16 lb. of carbo-hydrates, and 1 lb. of fat. From this we calculate that for each 1000 lb. weight of animal fed we supply 2·73 of protein, 13·33 lb. of carbo-hydrates, and 0·83 lb. of fat. This agrees so closely with the German standard that it might appear that I had got my ideas of the proper portions from them. This is not so, as it is only (1889) a few months ago that I learned the German standard, whereas I have worked on my principle for many years, and as yet I see no good reason for change in favour of the German.

"Frequency in feeding, with as much variety as possible in the bill of fare, and no greater quantity given at each time than will be directly consumed, are in my belief the first principles in successful feeding. To supply more than will be eaten at once is not only wasteful, but it encourages the animal to become dainty of its food, which bad habit in the end prevents the eating of a proper quantity. As soon as the animal has finished feeding let the man in charge clean most scrupulously the feed boxes, as daintily-fed animals loathe food that has been blown upon. It is seldom two animals feed alike, so the herdsman or feeder must study exactly the quantity each animal will consume. If they do not get sufficient they will remain restless, and not lay on flesh as they ought to; if they are overfed they become disgusted and refuse to eat. Many animals, if judiciously handled, will eat a heaped pailful of my mixture four times a day; that is, from 18 to 20 lb. at each feed.

"It is very necessary to question your stockmen daily as to the condition and health of the animals, as they are apt to forget to tell you if an animal shows any deviation from his healthy habits. Should sickness appear, avoid as much as possible the use of medicines. Overfeeding is generally the cause of sickness in pampered animals, and in such cases a good dose of linseed oil will give relief, but there is nothing to compare with *diet*. Keep the animals short of feed for a day or two, and they will soon return to their normal state.

"Now, for the main point—the feeding ingredients; in order to make the calculation simple of the measurement and mixing of the several meals, we will consider their relative weights by the pound, as follows:—

1. One pound oats, crushed.
2. One pound barley, crushed.
3. One pound maize or Indian corn, crushed into meal.
4. One pound wheat, crushed.
- 5 and 6. One half-pound peas, one half-pound beans, crushed into meal. (One pound peas can take the place of both.)
7. One pound bran.
- 8 and 9. One pound best flax seed, ground into flour, and one pint molasses; mix both together for soup, and divide into four portions, one-quarter for each feed.
10. One double-handful of sweet hay chaff given in every feed, so as to promote digestion and rumination.
11. One double-handful of pulped roots—about four pounds—in every feed, mixed with the grains.

"Mix all thoroughly together, and feed the animals *four* times a day, according to appetite and constitution. Water *four* times daily, and

always *before* feeding ; never fail to take the chill off the water during winter ; let the temperature be about 50° Fahrenheit. Make soup of the flax-seed and molasses ; put as much water in a pail as you think may be necessary to saturate the entire mess of meal, &c., with the soup, taking care *not* to make the meals sloppy. After thoroughly mixing the soup with the meals, your ration is fit for use."

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## CHAPTER XII.

### OF ARTIFICIAL FOOD FOR CATTLE—PREPARATION OF FOOD.

HAVING stated the different home-grown vegetable products which have been advantageously employed in feeding and fattening neat cattle, we proceed to speak of other articles and compounds which may also be used with benefit.

At the head of these stands linseed, and there is nothing superior to it for feeding or fattening cattle, or even for increasing the milk of cows.

Various experiments have tended to prove that linseed, when given whole, passes through the animals without undergoing much, if in some instances any, alteration : hence it cannot have done them the least good ; and, when crushed and given raw, it often leads to purging. It therefore becomes evident that, to obtain from the use of it those beneficial effects which it is so capable of producing, it is necessary that it shall undergo some process. The form in which it is most ordinarily given is that of linseed-cake, which is a mass of linseed whence the greater part of the oil has been crushed, and this provender certainly is most nutritious. Nevertheless, many experiments have been made with the view of discovering whether or not a still more advantageous use may not be made of linseed.

Preparations of linseed have been in use for the last sixty years. Mr. Hillyard used to steep the seed, after having crushed it, in cold water, in order to extract the mucilage ; but as this process was tedious, often occupying at least a week, he tried hot-water, and found that by its means he produced a better jelly, and in one-fourth of the time : but even this did not satisfy him, so he tried what boiling the linseed would do, and ended by adhering to this last system.

But it is Mr. Warnes, of Trimmingham, to whom should be awarded the merit of drawing attention to the best modes of using linseed, and to the importance of flax-seed as an adjunct to the system of fattening cattle. He ground it into meal and mixed it with boiling water, in the proportions of a pound of meal to a gallon of water,<sup>1</sup>

<sup>1</sup> "Journal of the Royal Agricultural Society," vol. viii., 1st series, p. 480.

and then mixed it with other substances, as, given singly, it was too oleaginous, and was apt to disagree with the animals. The following are some of the compounds proposed by Mr. Warnes for feeding animals put up to fatten :—

1st. A mixture of three parts bean, pea, oat, or barley meal is incorporated with one part linseed meal. This latter is first reduced to a mucilage in the manner above described, and the other meal is then incorporated with it. Bran, the chaff of corn or flax, or cut grass or turnips, according to the season, may be added. The mixture is not given to the cattle until cool. It will keep for a week, if the air is excluded from it.

2nd. Turnips, carrots, mangel, cabbage; or potatoes may be taken, cleansed from dirt and sliced, then put into a boiler with enough water just to cover them. As the roots are cooked they should be removed a little at a time into a strong vessel close at hand, and there mashed by one person, while another strews linseed meal over them, so that it may become thoroughly incorporated with the mass. When the whole is mashed, and the proper quantity of meal intermixed, it should be rammed down and the vessel covered over, in order that the heat may be retained sufficiently long to amalgamate the meal with the other ingredients.

3rd. Take clover or any other grass, or bean or pea haulm, or hay or straw, and chop up fine, or chaff or bran, and mix with the linseed mucilage, either separately or conjoined, so as to form a consistent mass. Cover it up close, in order that the heat may be retained as long as possible, and thus partially cook the whole, and give it to the animals when it begins to cool.

The quantity of these compounds to be given per day will depend upon the size and condition of the animal, but in all circumstances it is better to give a little and often than to run the risk of nauseating the animal by large meals.

Mr. Nicholls, from whose excellent paper on "Box Feeding with Linseed Compounds" we have been quoting, describes Mr. Warnes's system as being one of the best and most economical that can be practised for feeding cattle, both from its excellent effects on the animals and from the quantity and superior quality of the manure it yields.

Mr. Marshall's compound for fattening cattle is as follows :—

3½ gallons of water.  
2 lb. of linseed meal.  
5 lb. of barley meal.  
10 lb. of chaff.

The above is the allowance per day for each animal.

Mr. Hillyard gave his cattle

9 lb. of cut hay.  
2 lb. of boiled linseed.  
2 lb. of boiled potatoes.  
¼ lb. of molasses.  
3½ gallons of barley and bean meal mixed.<sup>1</sup>

<sup>1</sup> "Farmer's Magazine," 1850, vol. xxi. p. 191.

The *adulteration of seed oil-cakes* is unfortunately carried out to such an extent as to render the following remarks of the late Dr. Voeleker, on the testing of them, peculiarly valuable:—

“Let me point out how you may examine cake, so as to be able to form some opinion as to its qualities. An excellent way of examining all descriptions of cake is to reduce them to powder. I should recommend for the purpose a common kitchen grater. You should grate it till you have about half an ounce of powder. It is better to powder it in the way I have mentioned than to reduce it in a mortar to a fine powder, for in that case you would be likely to destroy the character of the seeds of weeds, and reduce the bran, if there is any present, into a condition too fine for examination. The powder should be mixed with about five ounces of water. With good American cake the mixture is transparent, light-coloured; it produces a stiff jelly, which is very agreeable to the smell and the taste. The cake is so nice that one might almost eat it with pleasure. If, however, you examine foreign<sup>1</sup> cakes, which in nine cases out of ten contain other descriptions of oily seeds besides linseed, you will find the jelly to have a very disagreeable smell, often very much like a canary-bird cage; it smells like the refuse of canary-bird seed. This peculiar smell arises chiefly from the camelina seed in such cakes. Then I would also observe that the colour is quite different in good, clean, or bad cake. The latter has a dirty grey colour, and if you examine it with a pocket microscope you discover readily the particles that are not linseed. By diluting the thick paste with water and stirring it up, you can recognise the sand, which then subsides better. Then above the sand generally floats the bran, which can be recognised by its structure. Indeed, by the simplest solution, or rather suspension in water, you can recognise a great many foreign matters in cake, and to some extent likewise recognise its condition.

“Then in addition to this examination, I would observe that in the case of rape-cake you ought to take half an ounce of the powder and mix it with six ounces of cold water, keeping the mixture in a stoppered bottle, and then examine it after the lapse of twenty-four hours—not before. It is a singular fact that rape-cake, even when containing a very large proportion of mustard, has no smell whatever, nor is the smell developed immediately on mixing with water. The fact that the smell of mustard does not appear within an hour, or even two or three hours, does not prove the absence of mustard. But if you place the bottle in a tolerably warm room, or even in a common sitting-room, and do not find a strong smell after the lapse of twenty-four hours, you may safely conclude that there is not an injurious quantity of mustard present. If the smell is very strong, more particularly if the taste is strong, mustard is present in injurious quantities. I lay particular stress upon the last remark, if the taste is strong, because all rape-seed is to a certain extent pungent; indeed all the seeds belonging to the Brassica species develop a strong smell, but you do not get anything like that pungent taste in the specimens I have sent round. It bites you on the tongue, and rape-seed never does that. Of course

<sup>1</sup> This is much less the case now (1892) than twenty years ago.

there are occasions when a more perfect examination is required, and there are other tests of a more chemical character which I have noticed, but as they are more difficult of manipulation, I thought it best to remain silent respecting them, pointing out only the simple test which I have given, one that is really very useful, and can be handled by every man. I have given you a brief outline of the method which, after all, I am myself frequently obliged to follow, in addition to the chemical examination to which I submit the cakes when sent to me for that purpose."

An instructive article on the purity of linseed cakes, communicated by Dr. J. A. Voelcker to Morton's "Farmers' Almanac," suggests some modification of the foregoing. From it the following details are taken:—

"It is unfortunately the case with linseed cakes, that much which in the crude state would stand out boldly by its different appearance, may in the finely ground and crushed state be only too readily made to lose its distinctive character and to supply the place of a more expensive article. Although here and there a so-called 'pure' cake may be so glaring by the admixture of what is not linseed as to lead to suspicion in the minds of even those who are not experts, by reason, it may be, of a bad or bitter taste, a pungent smell, the presence of a quantity of black husk, or even sometimes by a believed grittiness, these are but the exceptions, and the vast majority would go unnoticed, for they are such as only the practised skill and the special appliances and methods of the expert can detect. And what are these impurities, and how may they be detected? So formidable is the list of them that their description alone would involve space far greater than is at my present disposal. Moreover, the work has already been so fully and ably done by the late Dr. Voelcker in a paper (from which our page 200 is quoted) entitled 'Pure and Mixed Linseed Cakes' ('Journal R. A. S. E.,' 2nd series, vol. ix., part 1), that it would be needless to repeat it. I wish rather to confine myself to what may be called the later, most flagrant, and most fashionable developments of the art of 'mixing.'

"Prominent of late amongst adulterants has been rape-seed from which the oil has been for the most part extracted by chemical means. An analysis of this material is given below:—

Moisture . . . . .	7.98
Oil . . . . .	5.54
*Albuminous compounds (flesh-forming matters) . . . . .	33.12
Mucilage, digestible fibre, &c. . . . .	32.07
Woody fibre . . . . .	13.61
†Mineral matter (ash) . . . . .	7.68
	100.00
*Containing nitrogen . . . . .	5.30
†Including sand . . . . .	2.44

"This material seems to have found special favour, it being offered for sale with the strong recommendation that it is impossible to detect it by analysis. So popular has this particular adulterant become, that its market value, starting from 20s. or so per ton, has gradually increased up to 4l. per ton. After procuring some of this material

I had cakes made up from a mixture of 5 parts of it with 95 parts of linseed (of 97·16 purity), and also other cakes containing respectively 10 and 30 per cent. of the refuse. Table I. represents the analyses of these mixed cakes:—

TABLE I.

Ingredients.	Pure linseed cake.	Linseed cake with 5 per cent. rape refuse.	Linseed cake with 10 per cent. rape refuse.	Linseed cake with 30 per cent. rape refuse.
Moisture . . . . .	10·29	12·28	10·97	11·32
Oil . . . . .	12·66	11·33	10·53	10·60
*Albuminous compounds (flesh-forming matters) . . . . .	28·59	29·57	28·93	30·87
Mucilage, digestible fibre, &c. . . . .	34·85	32·37	35·19	31·07
Woody fibre . . . . .	8·07	8·81	8·80	10·16
†Mineral matter (ash) . . . . .	5·54	5·64	5·58	5·98
	100·00	100·00	100·00	100·00
*Containing nitrogen . . . . .	4·57	4·73	4·62	4·94
†Including sand . . . . .	·59	·80	·59	1·09

“ Taking these figures, there is not one single constituent that could be pointed out as indicating the least suspicion of the cake being impure. The sand is not high in any of them, nor is the woody fibre exceptional. In the mixtures containing 5 and 10 per cent. respectively, the fibre is but little more than in the pure linseed-cake, and even where 30 per cent. of the adulterant is added, it is not more than frequently occurs in pure cakes. Nothing in short is to be gathered from the figures alone, so far as this particular adulterant is concerned.

“ Coming next to the *appearance* of the cakes, the admixture of 5 per cent. of rape refuse was almost impossible to detect by the eye alone, and it was only when I submitted the cake to microscopical examination that I was able to detect the presence of rape. It is quite clear to me that the statements of the vendors of this material as to the impossibility of detecting it by analysis have justification so far, that, unless the cake containing it be most carefully and microscopically examined, the presence of the mixture may pass unheeded; and I have no hesitation in stating my belief that many a cake of this nature has been passed as ‘pure.’ It is most difficult to distinguish by the eye between the husk of this rape-seed and the husk of linseed; and as it, like linseed, gives no starchy reaction, it is not in this way discernible. The admixture of 10 per cent. of the rape-seed was not more than just noticeable by a practised examiner, and by any one else not perceivable. When 30 per cent. was added, the cake had a somewhat bitter taste, but the outward appearance of it gave no indication of admixture. Other cakes I had made up composed of different materials mixed with linseed—viz., cockle-seed, cockle and buckwheat mixed, and lastly what is termed ‘mill-sweepings.’ In Table II. are given the analyses of these materials, and also of cakes made up of various mixtures of them.



TABLE II.

	Cockle seed.	Cockle seed and Buckwheat mixed.	Mill sweepings.	Linseed cake with 10 per cent. Cockle seed.	Linseed cake with 10 per cent. mixed Cockle seed and Buckwheat.	Linseed cake with 10 per cent. Mill sweepings.	Linseed cake with 5 per cent. Rape refuse, 5 per cent. Cockle seed, 5 per cent. Buckwheat mixed, 5 per cent. Mill sweepings.
Moisture . . .	9.95	9.70	7.97	11.82	11.93	11.53	10.96
Oil . . .	6.54	5.01	2.80	11.87	10.70	11.07	12.07
*Albuminous compounds (flesh-forming matters)	13.06	12.25	12.87	26.75	26.12	26.94	25.62
Mucilage, digestible fibre, &c. .	56.04	56.55	38.03	36.67	36.60	34.84	34.87
Woody fibre . . .	5.81	7.84	11.27	7.76	8.76	8.03	9.76
†Mineral matter (ash) . . .	8.60	8.65	27.06	5.13	5.89	7.59	6.72
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
*Containing nitrogen . . .	2.09	1.96	2.06	4.28	4.18	4.31	4.10
†Including sand . . .	3.80	4.45	19.94	.69	1.44	2.24	1.89

“In the figures of these there is nothing absolutely exceptional. In the mill-sweepings mixture, alone, is the sand sufficiently high to call for comment. Unlike in the admixture of rape, the present series are very discernible by chemical tests for the presence of starchy bodies. The cake with mill-sweepings in it had a somewhat dirty appearance, and the presence of cockle, buckwheat, and mill-sweepings was discernible clearly by the microscope. From what I have stated, it is clear that it is quite fallacious to decide by the figures of chemical analysis alone whether a cake is pure or not, and that to determine this point a careful microscopical examination, made by an experienced observer, is necessary. It would be quite hopeless to give any directions to non-experts by which adulteration could be detected.

“What should then be termed a ‘pure’ cake? Absolute purity, *i.e.*, that the cake should not contain a particle of anything not linseed, is an impossibility. As absurd would it be to say that the presence of a single bit of wheat-husk or straw in a sample of wheat-flour rendered the latter an adulterated article. Much is heard of the term ‘95 per cent. pure’ as applied to linseed-cakes, but whilst it is quite possible to determine by mechanical separation the exact percentage of linseed in a sample of seed, yet, after the materials have been crushed and the oil expressed, no means exist, chemical or otherwise, of separating and ascertaining absolutely how much of a cake consists of linseed only. The most that can be given is an approximation.

“The evil of accepting a standard of 95 per cent. is that, in so doing, no cognisance would be taken of what the nature of the other 5 per cent. was. For instance, some impurities, such as castor oil bean, might be contained in it, of which a far smaller amount than the allowed 5 per cent. would render the cake positively poisonous. To

any such standard figure it is necessary, therefore, to add the qualification that the impurities shall be (1) quite harmless, and (2) only those incidental to the seed. With regard to impurities incidental to cultivation, I am confident that, were crushers to insist upon having a high quality of seed, inducement would be given to the cultivator of it to be more careful than he is at present. The fact of there being a ready sale for linseed containing a considerable percentage of foreign seeds, dirt, &c., has done more than anything else to raise the quantity of so-called 'incidental' impurities of linseed. Were the crusher only to buy seed of high standard and to use reasonable precautions in screening it before crushing, there would, I believe, be no difficulty in producing a cake which could rightly be termed 'pure.'

"Against sophistication of any kind, whether to the extent of 5 per cent. or even less, the agricultural chemist must set his face firmly, and not hesitate to condemn it wherever he has reason to believe it has occurred. To decide whether the presence of rape in a cake is an incidental impurity or a positive admixture is, of course, a most knotty point; but it has been clearly shown to me that it can be done.

"Perhaps the only constituent of linseed-cake to which a definite figure may be given as a standard is the sand; for it must be apparent to every one that this ingredient, which is quite valueless as food, and if present in excessive quantity may indeed be injurious, has to be paid for just as if it had been linseed. If good-quality seed has been used, and screening has been conducted with reasonable care, there should, I think, certainly not be more than from 1.5 to 2 per cent. of sand, and there might well be less than even the lower figure, as in the case of the linseed cakes of which I have given the analysis. There remains but one point more, and that is the necessity of a proviso that the cake should be made from *sound seed*, and be delivered in good merchantable condition.

"To sum up these conclusions, the following are the essentials for a linseed cake being considered a pure one:—

"(1) That it be made from sound seed of not less than 95 per cent. purity, subsequently well screened.

"(2) That it contain no ingredients of a poisonous or deleterious nature.

"(3) That it be entirely free from sophistication of any kind.

"(4) That it contain not more than 2 per cent. of sand.

"(5) That it be sold in good, merchantable condition."

*Decorticated Cotton Cake* is a most useful article for fattening cattle, even superior to linseed-cake in nutritive value, while the value of the manurial residue from it is higher than that from anything else. The writer believes that no other kind of manure, either natural or artificial, can produce such heavy crops of grass. But cattle will not eat it so freely as they will eat linseed-cake, and it is a good plan to mix with it an equal quantity of the last named. It is also less in price than linseed-cake, though not so much as it was before farmers had discovered its value as a feeding stuff.

*Undecorticated cotton cake* is useful on land whose herbage has a

tendency to unduly relax the bowels of cattle; the husk contains an astringent property which corrects the aperient effects' of the grass. Neither of these kinds of cotton cake is suitable for young animals.

An important question, but one upon which practical farmers are not agreed, is whether decorticated or undecorticated cake is the better form in which to make use of the refuse cotton seed for the purpose of feeding stock. Both, it is admitted, are valuable and economical foods, but some feeders maintain that the undecorticated or common cotton-cake is the safer and better to use, because it is free from the hardness and indigestible lumps which too often characterise the decorticated cake, and because the husk left in it imparts a wholesome astringency to the diet. Others who have had experience of the decorticated cake are ready, on the contrary, to maintain that, if reasonable precaution be exercised, and the worst class of cake be avoided, there is no difficulty in feeding with it, and that it will amply repay the trouble and give a decidedly better result.

Experiments bearing upon the question are described in a paper upon "The Comparative Feeding Values of Decorticated and Undecorticated Cotton-Cake," which Dr. J. A. Voelker contributed to the "Journal of the Royal Agricultural Society," 1891. At the Royal Agricultural Society's Experimental Farm at Woburn, eight Hereford bullocks, three years old, were divided into two lots of four each, the total weight of each lot being the same. Both lots received the same quantities of griddled barley and of linseed cake, whilst Lot I. had decorticated cotton-cake, and Lot II. an equal weight of undecorticated cotton-cake. In addition, they were allowed as much roots (swedes first, mangel later) and hay chaff as they would eat. The experiment lasted 145 days, at the end of which period it was found that the animals of each lot had eaten, per head per day, as follows:—

	Lot I. Dec. cake lb.	Lot II. Undec. cake lb.
Cotton-cake . . . . .	3.30	3.30
Linseed-cake . . . . .	2.88	2.88
Barley (griddled) . . . . .	4.00	4.00
Roots . . . . .	40.00	40.34
Hay-chaff . . . . .	8.88	8.88
Water . . . . .	36.30	27.61

It is instructive to notice that the animals in each lot ate identical quantities of hay and within one-third of a pound of the same quantity of roots per day, although the supplies of these two fodders were unlimited. During the entire period, Lot I. increased in weight at the rate of 2.21 lb. per head per day, and Lot II. at the rate of only 1.97 lb., the difference of 0.24 lb. per head per day in the increase denoting the superiority of decorticated over undecorticated cotton-cake, this being the only difference in the rations consumed. It was calculated that, for feeding purposes alone, and omitting manurial value (which would put the balance still more in favour of the decorticated cake), decorticated cotton-cake is fully worth 50s. a ton more than undecorticated cotton-cake.

This experiment was repeated the next year with Shorthorn bullocks

instead of Herefords, and with eight animals in each set. The trial occupied 120 days, the results being:—

Grain per head per day with Decorticated Cotton-cake . . . . .	2.38 lb.
"                    "                    Undecorticated Cotton-cake . . . . .	1.84 "

*Rape-Cake* is less relished by cattle than linseed-cake, and they require to be coaxed into partaking of it; once habituated to it, they consume it freely. Dr. Voelcker says he believes "the pungent principle in rape-cake arises from the presence of mustard-seed, which is often contained in considerable quantities in foreign rape-cake. Mustard and rape-seed belong to the same family of plants; and in Germany, at least, I am sorry to say, our rape-fields are often very foul with mustard. That boiling water prevents the pungent acrid smell is fully explained by the chemistry of mustard-seed. That seed does not contain any volatile or essential oil of mustard, the cause of the pungency of mustard taste; but it does contain two peculiar principles, which, in contact with cold or tepid water, generate essential oil of mustard—the one is called by chemists 'myronic acid,' the other 'myron.' The latter is a substance like albumin, and, when moistened with cold water, acts as a kind of ferment upon myronic acid, producing the acrid oil of mustard; whereas boiling water coagulates myron like albumin. In a coagulated state myron loses its efficacy as a ferment, and consequently no pungent or acrid smell is produced when cake containing mustard is mixed in boiling water. . . . However, the practical result of mixing rape-cake with boiling water deserves to be generally known, for even pure mustard-cake will lose its poisonous character—or, more correctly, its poisonous qualities will not be called into existence—if it be mixed with water at the temperature of 212° Fahr."

While on the subject of oil-cakes, it will be interesting and instructive to give here a *résumé* of the experiments of Crusius, to determine the influence of the oily matters in food on the fattening of stock: for this, with the accompanying remarks, we are indebted to the pages of the "Scottish Farmer":—

"For this purpose twelve oxen, as nearly similar as possible, were selected and divided into two series of six each. These were supplied with mixtures of different foods, so adjusted as to contain as nearly as possible the same quantities of dry matter, nitrogenous compounds,

TABLE SHOWING THE DAILY QUANTITY OF FOOD GIVEN TO THE SIX OXEN OF EACH SERIES.

	1st Period.		2nd Period.		3rd Period.	
	1st Series.	2nd Series.	1st Series.	2nd Series.	1st Series.	2nd Series.
	lb.	lb.	lb.	lb.	lb.	lb.
Hay . . . . .	60	54	60	60	60	60
Rye chaff . . . . .	24	24	36	36	36	36
Malt dust . . . . .	18	18	18	24	...	...
Peasemeal . . . . .	24	12	24	36	12	12
Bran . . . . .	...	12	...	12	42	42
Potatoes . . . . .	42	170	124	124	216	216
Rapecake . . . . .	36	...	30	...	...	..
Oil . . . . .	8	...	3	...	...	...

and woody fibre, but so that the first set got a large and the second a small quantity of fatty matters. So general is the distribution of fat, that some difficulty was experienced in finding substances sufficiently free from it to produce a proper contrast; and it was only by the use of malt-dust on the one hand, and of rape-cake mixed with oil on the other, that it was possible to obtain the requisite difference. The feeding was divided into three periods, and the nature and quality of the food given will be best understood from the table on page 206.

“These quantities were so arranged as to give as nearly as possible the same amount of nutritive matters to each series, except that the first got about twice as much oil as the second. This is more distinctly seen in the following table, calculated from the analyses of the different foods, and giving the exact amount of each nutritive ingredient consumed per head:—

	Dry matter.	Nitrogenous substances.	Non-nitrogenous substances.	Total nutritive matters.	Woody fibre.	Fat.
	lb.	lb.	lb.	lb.	lb.	lb.
1st Period, 1st Series . . .	24.7	5.03	12.98	18.02	6.3	1.82
"    2nd " . . .	24.4	3.44	14.86	18.30	4.8	0.75
2nd Period, 1st " . . .	29.1	5.09	16.52	21.51	5.9	1.80
"    2nd " . . .	29.5	6.16	16.72	22.88	5.8	0.90
3rd Period, 1st " . . .	30.6	3.75	20.07	23.82	5.5	1.90
"    2nd " . . .	30.6	3.75	19.07	22.82	5.5	0.90

“Without entering into the details of the weighings at each successive period, which were made with great minuteness, it may suffice to give the subjoined abstract of the results:—

	1st Series.	2nd Series.	Excess of gain in weight of 1st over 2nd Series.
	lb.	lb.	lb.
Original weight of the animals . . .	6,688	6,963	...
Gain during 1st Period (21 days) . . .	368	301	67
"    2nd " (21 days) . . .	577	318	259
"    3rd " (14 days) . . .	326	241	85
Total gain : . . .	1,271	860	441

“Looking at these results, it seems impossible to doubt that the larger gain which appears throughout the whole of the first series must be due to the excess of fatty matters supplied in the food. And this is very strikingly seen in the last period, when exactly the same quantities of the same substances were given to each series, except that the first received 84 lb. of oil more than the second, and the conclusion is irresistible that the surplus gain of 85 lb. must have been produced by it. Neither can it be doubted that the 259 lb. by which the first series exceeds the second during the second period is caused by the additional 113 lb. of fat contained in the food.

“Not only does the first series increase more rapidly than the second, but it appears that the animals make a better use of their food, and digest and assimilate a larger quantity. Thus, for example, during the second period, the first series require 467 lb. of nutritive matters to produce a gain of 100 lb. of live weight, while the second series require 906 lb.; and this corresponds also with the composition of the dung, for Crusius finds that of the first series to contain daily 1 lb. of solid matter less than that of the second.

“It is clear, then, that the addition of fatty matters to the food is useful, not only by supplying that necessary ingredient, but also in so far as it promotes the assimilation of its other constituents; but it still remains to be determined whether it will pay. Into the consideration of this point also Crusius enters very minutely, and shows, from the actual cost of the food and prices realised in the market, that the profit derived from each pound of live weight acquired by the animals amounted to 1½*d.* It must be borne in mind, also, that the question of economy was not considered in fixing the nature and quality of the food, the object being to effect the most complete comparison between substances differing only in the oil they contained, and hence it became necessary to employ oil itself, of which the cattle, in the course of the experiment, consumed about two cwt., at a cost of 4*l.* 10*s.*, while, had it been possible to disregard the composition of the food in other respects, it might have been supplied at one-tenth of this price.

“These experiments, although they by no means exhaust this subject, are peculiarly interesting because they show that a positive advantage is gained by increasing the quantity of fat in the food, and they justify the preference which the feeders of this country have always shown for oil-cakes of different kinds. They open up also the question of whether oil itself may not be at times an economical food. It is perfectly conceivable that there may be a mixture of foods the digestibility of which may be so greatly increased by the addition of a comparatively small quantity of oil as to render its use remunerating. We have been informed, indeed, that linseed oil was used to some extent in feeding sheep during last winter, and with excellent results.”

In the *Journal of the Royal Agricultural Society*, Vol. XXV., second series, 1889, Mr. F. I. Cooke details a series of experiments on the value of the oil in linseed-cake as food for stock. He commences:—

“It is very well known that owing to modern improvements in machinery, and an increase in the value of oil, as compared with the large reduction in price of linseed-cake, the latter product contains now a less amount of oil than was commonly found in it a few years ago. A diminution in the percentage of oil in a cake is necessarily accompanied by an increase in the other constituents, and arguments have recently been advanced by German and other authorities tending to show that a cake low in oil may have a feeding value equal if not superior to one containing a larger amount of oil. On the other hand, many of our leading agricultural chemists have continued to put a much higher value per unit, for fattening purposes, upon oil than upon any other nutrients in a cake. Considering, therefore, this prevailing

uncertainty, and the very large amount of linseed-cake used by the farmers of Great Britain, the present writer has long thought it a matter of the greatest importance to them that the question of the feeding value of oil should be accurately determined by practical experiment."

The experiment was carried on with two cakes, one of which contained between 6 and 7 per cent. of oil, and the other between 15·36 and 16·21 per cent—a difference, therefore, of from 9 to 10 per cent. of oil. The investigation took place at Mr. Garrett Taylor's farm, at Whitlingham, Norwich, two sets of thirty pure bred Southdown ewe lambs being employed. Omitting details, it may be stated that in the end each lot of thirty sheep had consumed rather over one ton of cake. The difference in market value between the two cakes, as nearly and fairly as could be estimated, was 20s. to 30s. per ton. The increased value per sheep of the high oil pen, according to the scales, was 2s. 5d. per head, or a gross gain of 3l. 12s., over the low oil pen, in return for an extra expenditure—had it been bought at market rates—of 20s. to 30s on the dearer material. In addition, however, to this profit of 100 or more per cent. on excess of outlay upon a richer cake, there is the further problematical gain, beyond that recorded by the weigh-bridge, arising from the displacement of water by fat in the riper sheep, for which there is considerable evidence, if no actual proof. By estimate of experts also, the superior market value of the best pen of sheep was, at the higher figure named by them, 3s. per head or 4l. 10s. per pen, which is slightly in excess of the record of the scales. However, in any case an extra increase of 2s. 5d. was clearly obtained by use of the high oil-cake, for an extra expenditure upon it of 8d. to 1s. per sheep.

"It therefore follows," concludes Mr. Cooke, "that a linseed-cake, containing 15 per cent. of oil, and costing on that account some 20s. to 30s. more money per ton, may not only be used with great advantage to grazing sheep, but with considerable profit to the farmer. Or, to put it in another way, it is now very decisively proved that, weight for weight, linseed-oil, to the extent of 15 per cent., in a cake, has a much higher feeding value than have the other constituents of a linseed-cake which in the absence of the oil would replace it. So that all the recently expressed opinions, English and Continental, on the equal or even superior value of certain cakes low in oil, as compared with some more oily ones, are altogether false. In grasping this lesson, however, it will be well to bear in mind that all oil is not linseed-oil—the kind which was used with such remarkable advantage in these experiments. For it is to be feared that now the value of linseed-oil is so conclusively and publicly demonstrated, oil of another and very inferior kind may find its way into the farmers' cakes, with very inferior results upon the farmers' stock."

The *pulping of roots* is one of the more recent innovations in cattle-feeding. The following is an account, by Mr. W. Karkeek, of the mode of feeding adopted on the farm of Mr. R. Davy, M.P., where the pulping is part of the system:—

"We found thirty-two North Devon cattle kept in separate boxes in

two houses recently built. They were fed in wooden troughs, eighteen inches wide by twelve inches deep, with a mixture of grated turnips and straw chaff, in the proportion of 90 lb. of the former to 7 lb. of the latter, mixed in the following manner:—The grated turnips (swedes) are intimately mixed with the chaff in a bin sufficiently large to supply the cattle with one day's food. These ingredients are allowed to remain in the bin three days, during which time fermentation and heat are produced on the mass, sufficient to cook the whole, as if it had been submitted to the power of steam. We observed that an odour is emitted, during the fermentation, similar to fresh brewer's grains, evidently the consequence of the saccharine matter evolved from the roots and chaff. There were three bins constantly at work in this manner, so as to afford a regular daily supply. 97 lb. of this mixture is given to each animal, and 4 lb. of linseed-cake per day, in the following manner:—1st feed, 6 o'clock A.M., mixture of chaff and turnips; 2nd feed, 9 o'clock A.M., mixture of chaff and turnips; 3rd feed, 12 o'clock noon, 4 lb. of cake; 4th feed, 1 o'clock P.M., mixture; 5th feed, 4 o'clock P.M., mixture. In addition to this, about 3 lb. of dry chaff is given during the evening. The cattle are exceedingly fond of this mixture; so much so that there has been some difficulty experienced in getting them to eat the linseed-cake. In ordinary feeding with turnips, it is always observed that cattle will consume the cake in preference to roots; but not so in this case, as the mixture is preferred to the cake.

“The cost of feeding cattle in this manner was estimated by Mr. Tresawna, Mr. Trethewy, Mr. H. Croggan, and Mr. Whitford (who accompanied me on my first visit to Polsue farm), at six shillings per week, which includes turnips, chaff, and oil-cake. This system of feeding evidently agreed with them in a remarkable manner, as the whole number were in an exceedingly good, thriving condition. They were purchased thirteen weeks since at the Truro fair, placed in the boxes on this system of feeding eleven weeks. We find they cost on an average 17*l.* each, total 544*l.*, and were at the present date all fit for the butcher, averaging, according to Mr. John Kendall's valuation, 7½ cwt. each, which, at the present price of beef, say three guineas per cwt., would produce 23*l.* 11*s.* each—total 752*l.* Deducting the cost of keep at six shillings per week, 105*l.* 12*s.*, from the present value, it would leave a clear profit of 102*l.* 8*s.*, or 3*l.* 4*s.* per bullock in eleven weeks, and this, too, exclusive of the valuable rich manure manufactured in the boxes. Some idea may be formed of the value of the manure. Each box was 8½ ft. square; the dung was allowed to accumulate in the box for two months; and on its removal, some three weeks since, each box averaged six loads of rich well-made manure, containing all the elements necessary for the healthy and luxuriant growth of all the different cultivated plants on a farm.”

Lord Kinnaird instituted a most elaborate set of experiments to ascertain the advantages of pulping roots, which, although not very conclusive, showed a saving of roots and an increase of weight by the use of pulped roots.

Since the date of the detailed experiments above alluded to in the



use of pulped food for cattle, it is necessary to state that the opinions of many who then held that pulping was an economical method of preparing food, and that pulped food was beneficial to animals, have received very considerable modifications; so considerable indeed that pulping is carried out to a very much less extent than it was. One of the best, at least one of the most striking evidences of this, is to be met with in the implement department of our show yards. Some years since pulping machines were to be seen everywhere, and the sale of them was very large. Although still used, and therefore still sold, the sale has fallen off so considerably that it is a somewhat difficult thing to find specimens on "stands" at which they formerly were a decided feature.

When a considerable change takes place in any practice there are good reasons for it, and it is worth while to enquire into its cause. In this case it is specially so, not only from its practical importance, but from the interesting physiological points connected with it. Turnip slicing and turnip pulping come under two different classes of processes, and are designed to serve two different ends; although, to a certain extent, root slicing embraces both. In the slicing of roots economy is chiefly aimed at, for in eating a whole root, not only has the animal a difficulty in getting hold of it,—and this chiefly on account of its spherical form, which gives it a continual tendency to slip out of its mouth,—but the process of munching it, so to say, is consequently so tedious that after a while the animal gets tired of it and leaves it. Now when once food is thus left by cattle it is worthy of remark that they will not return to it; or if they do, it will only be under the pressure of hunger. The probability is that the continued breathing of the animals upon the root, and its being covered with the saliva which issues so plentifully from their mouths during the process of eating, gives it a peculiar odour or flavour that they have quite a dislike to. Be this as it may, the fact remains that to give cattle whole roots is a very wasteful way. Hence it was seen at a very early stage in the history of modern farming that some method of dividing the roots so as to enable the cattle to get an easy bite at them would result in some saving. At first this was done simply with a knife, or with the part of the old sickle used to top the turnips, or rid them of the shaws or leaves. This was a slow process, so slow that it could not be applied where the cattle were numerous. Hand-wrought lever slicers were next introduced; these greatly aided the cutting process, but still the full work done by them, even with the most active of cattle-men, was far behind the requirements of large, indeed even of comparatively small, establishments. At length the ingenuity of our machinists, urged by the necessities of the case, and by the no less forcible appeal made to their pockets by the certainty that if a good machine was designed to do the work it would meet with a large sale, resulted in machines, more or less effective, being introduced capable of doing work on the large scale; and these were gradually improved, till we now have them capable of giving the maximum of work with the minimum of labour.

When the system of slicing roots became a regular part of the work of the cattle-feeder, it was soon noticed that not only was there a great

saving effected in the consumption of roots, by the avoidance of the waste above noticed, but it seemed as if the sliced roots "went farther," as the phrase goes, in feeding than did the whole roots, as the animals required or, at all events, took less to produce the same results. Another advantage was obtained from the system—namely, that it enabled the sliced roots to be easily mixed with other feeding materials. Amongst those were cut straw or hay; the cutting of which by machinery, introduced about the same period as the slicing of roots by the same agency, seemed to "fit in" very aptly, enabling the feeder to carry out quite a new system of giving food.

Seeing, then, the benefits in more ways than one of dividing or slicing the roots given to cattle, it seemed to some feeders that it was only necessary to carry the principle farther by mincing the roots—that is, cutting and cross-cutting them till they assumed the form of small pieces. Others, again, conceiving that the principle could be carried even to its utmost limits with advantage, adopted the system of "pulping" roots, after the same manner as carrots are grated by the cook. The idea being that the finer the subdivision the more rapidly would their assimilation into the system be, and that therefore the less weight would be consumed to give the same results.

From experiments made in the feeding with pulped roots, as already detailed, it was shown that this system of pulping was successful in some instances. But it was gradually noticed that cattle did not advance so rapidly or thrive so well on the finely divided roots as on the simply sliced ones. And a little study of the physiological condition of the case would show how this was likely to arise. An ox or a cow has a very large stomach. It requires, therefore, bulk in its food in order to fill it; and it is only when filled, or moderately so, that its functions are performed properly, and rumination is aided. Now the pulped food being capable of compression, and lying closely together, did not possess the necessary bulk. But another point was discovered in connection with pulped food; it being presented to the animal in a finely comminuted condition, it was capable of being swallowed without being first masticated; and the animal, as a rule, was found so to swallow it that mastication was neglected. Now we know that mastication in itself produces very healthy effects, and hence the necessity of its being encouraged. We do not here pretend to give this statement as that of the facts as they actually came up in the sequence of practice, and as those which influenced the question of pulping, and caused it to be much less frequently used than it was at one time; but the probability is that they followed pretty closely the line we have indicated. That line we have been somewhat careful to explain fully, inasmuch as it may be taken as an example of how certain practices may be analysed, so to say, and the reasons made clear why they are either followed out more and more exclusively, or, on the other hand, gradually given up. That pulping may be useful on some occasions in feeding stock is clear enough; and by a judicious use of it along with other methods of giving food, the disadvantages it presents, as named above, may be got rid of. One lesson, however,

may be learned from the facts we have stated,—that it is not good practice to adhere closely to any one system to the exclusion of others ; that, as we have seen changes of food to be good, so also does it appear to be that changes in the methods of preparing and of giving it are also beneficial.

On many farms, in some seasons, the stock of roots and hay for various reasons is but scanty ; the best efforts of the feeder are therefore demanded in order to find out some economical mode of supplementing them, if not of finding substitutes for them. A substitute or supplement of a valuable kind has been found in bruised linseed and bean-meal in equal proportions mixed with damped cut hay, or if hay is very scarce, with straw chaff. Where a copper or boiler is on the premises, the cooking of the food may sometimes be adopted with advantage. In this case, to every quart of boiling water stir in one pound of bean-meal ; this should be mixed with the quantity of linseed-meal intended to be used, and also with the chaff. It appears that, according to the estimate, 4 lb. of this food is equal to 19 lb. of roots.

As to the comparative profit derivable from the various kinds of food used, the following results of a carefully conducted set of experiments recorded in the Transactions of the Highland and Agricultural Society of Scotland will be useful :—

“ Six bullocks that were bred upon the farm were equally divided into single boxes ; they were supplied with cut roots—the first month swedes, the second swedes and mangel mixed ; latterly, mangel ; in addition they had 6 lb. of rough or low meadow hay cut into chaff, and 5 lb. of oil-cake, or value to that amount. They were divided into three lots of two each : lot 1 had 5 lb. of oil-cake each bullock ; lot 2, barley and wheat-meal to the same value ; and lot 3, bruised linseed. The oil-cake cost 10*l.* 10*s.*, barley and wheat-meal 8*l.* 15*s.*, and the bruised linseed 13*l.* per ton. The experiment lasted four months, or 112 days ; each bullock was weighed before putting up, and every successive month. It was found that the increase at the end was as follows :—

- Lot 1. Oil-cake gained live weight 637 lb.
- Lot 2. Wheat and barley meal do. 669 „
- Lot 3. Bruised linseed do. 718 „

It is thus shown that linseed gave most weight for value consumed, and oil-cake the least. As already stated, the experiment was continued for 112 days ; we therefore find that each bullock during the time consumed 5 cwt. oil-cake, or value to that amount, 6 cwt. of hay chaff, and 90 cwt. of roots. It is found that the average increase was 337 lb. each live weight, which is equal to 16 stones (14 lb.) dead. The feeding statistics will stand as follows :—

	£	s.	d.
5 cwt. of oil-cake at 10 <i>l.</i> 10 <i>s.</i> per ton . . . . .	2	12	6
6 cwt. of low meadow hay at 60 <i>s.</i> per ton . . . . .	0	18	0
16 weeks' attendance at 6 <i>d.</i> per week . . . . .	0	8	0
		3	18
16 stones of beef gained, at 8 <i>s.</i> per stone . . . . .	6	8	0
	£2	9	6

thus leaving us 49s. 6d. for 90 cwt. of roots consumed, or 11s. per ton."

*Brewers' grains* are sometimes given to cattle in an acid state; but *distillers' grains* differ from them in having a proportion of rye frequently mixed with the malt, rendering them more than naturally sour. Acid mixtures, however, can only be considered as preparatory to the more forcing and essential articles of dry food, without which it is impossible that any bullock can acquire the firmness of muscle and fat which is so deservedly considered as the criterion of excellence. *Brewers' grains* are much used in certain districts for dairy cows.

The *wash*, or refuse of malt remaining after distillation, which was formerly applied exclusively to the feeding of swine, has of late years been used with some success in the stall-feeding of cattle. It is conveyed from the distillery in large carts, closely covered and well jointed, in order to prevent leaking. The liquor is then discharged into vats or other vessels; and when these are about two-thirds filled, a quantity of sweet hay, previously cut small, is immersed in it for two or three days, in order that the wash may imbibe the flavour of the hay before it is used. In this state it is carried to the stalls, poured into troughs, and there eagerly devoured by the cattle. Sometimes, however, the beasts are at first averse to this mixture, in which case it has been recommended to sprinkle their hay with the wash. Thus, having the smell continually before them, and seeing other animals eating with avidity the same compound, they not only gradually become accustomed to it, but begin to relish it and fatten speedily.

One of the most successful instances recorded of this mode of fattening cattle was that of Messrs. Hodgson and Co., the proprietors of Bolingbroke-house distillery, Battersea, near London.<sup>1</sup> Between October and April they fattened about 450 cattle, having generally about 350 in the house tied up at one time, and 100 in an adjoining orchard, which were afterwards taken in to replace those that were sold off. There was no fixed period for fattening these bullocks, that being regulated entirely by the state of the markets; but from ten to sixteen weeks was the usual time, and the cattle were found to gain, upon an average, the extraordinary weight of from two to three stones per week. Their food was wash, grains, and hay—sometimes meadow and at other times clover hay—occasionally alternated with oat or barley straw, which was sometimes, although not regularly, cut into chaff. Hay or straw was given to them twice a day, in order that they might ruminate, and they had as much grains and wash as they could eat. In general they readily took to this kind of food, but some were four or five days before they lost their aversion to it.

The stock fattened at the distillery above named consisted of cattle of every sort and size. There were many Scotch cattle, or *Kyloes*, as well as those reared in Northumberland, Wales, and Herefordshire, but none of the *Sussex* or *Devon* breeds, which Messrs. Hodgson

<sup>1</sup> "Malcolm's Compendium," vol. i. p. 355.

and Co. judged too dear for them. According to their quality the cattle are supposed to pay from *five to twenty shillings* per week.

Messrs. Smith and Harrington, of Brentford, fattened 810 oxen on the refuse of 25,750 quarters of barley, with a certain quantity of hay. They were in tolerable condition when taken in, and averaged about 110 stones. In twenty weeks they acquired flesh to the amount of about 35 stones each.

In the preceding facts and statements we have referred chiefly to the feeding and fattening of middle-aged and old cattle; *young stock*, however, require particular attention lest their growth should be impeded, and therefore they should be fed on the best and most nutritive food which the farm can supply. A beast that has been starved when young can never be made profitable for any purpose.

During the winter they should have hay, turnips, and other roots, and oil-cake or bean-meal: or, if straw is substituted for hay, the proportion of other food should be increased, and given with considerable care. In summer, their food varies so little from that already described, as to require no particular details under this head.

Oxen, as already stated, are now rarely used in this country for draught, with the exception of a few districts in which the system is still persisted in; but in cases where they are used they ought to be well fed while they are kept in constant employment, particularly at the commencement of spring and in autumn, when their labour is most wanted. During those seasons, they should be supplied with plenty of cut hay and straw, or a good allowance of steamed potatoes, turnips, cabbages, or carrots, proportionate to the work, and to the quality of the fodder as well as of the roots. If the labour is unusually severe, a moderate quantity of oats, with bran, or some bean or pea meal, should be allowed. In summer, the beasts may be soiled with green food, and in the winter stall-fed.

A most important object in the feeding or fattening of cattle is that such arrangements should be made, and such a supply of food provided for winter consumption, that the grazier may be enabled to keep them throughout that trying season, and sell them when meat brings the highest prices, viz., from the beginning of February to the close of May. Thus he will not only obtain more for them than the autumnal markets would produce, but his stock will go off freely, and every market be in his favour. He will also obtain a considerable quantity of manure, and consequently be enabled to conduct his business to the greatest profit.

The *relative proportion of food* consumed by fattening cattle necessarily varies according to the size of the animals, and the nutriment afforded by the respective fodders. It has, however, been found, that an ox will eat nearly one-sixth *per diem* of his own weight of cabbages. Fattening beasts require from half a hundredweight to 75 lb. of turnips daily, besides an adequate allowance of dry meat to counteract the superabundant moisture of these roots. For middle-sized animals a bushel or a bushel and a half of distillers' or brewers' grains will be sufficient, if combined with an ample portion of cut hay, chaff, or bean

straw, given in the intervals of the distribution of the grains. Bullocks varying from forty-five to sixty stones consume about eight or ten stones of carrots or parsnips per day besides an additional quantity of dry provender, that is, in the proportion of one-sixth part of their own weight; and, as an acre of good carrots will yield 400 bushels, or 22,400 lb., it would support such an animal 160 days, a period sufficiently long for beasts to be kept that have had the summer's grass. If they are half-fat when put to carrots, an acre would probably be sufficient to fatten two such beasts. Of potatoes, small cattle—such as those of Wales and Scotland—eat every day about a bushel per head, in a raw state, with the allowance of a truss of hay divided between four beasts. To an animal of 7 to 8 cwt., from 3 to 6 lb. of oil cake are given daily, but, where bean-meal is used along with the oil-cake, 3 lb. of each may be given. A good allowance to each beast during winter will be 75 to 90 lb. of turnips, 14 to 20 lb. of hay, and 3 lb. each of oil-cake and bean-meal. Mr. Kennedy gives a bullock of 7 cwt. 60 to 70 lb. of swedes daily, and from 16 to 20 lb. of cooked food; 1 lb. of linseed or 2 lb. of linseed meal, boiled into mucilage, and mixed with 2 lb. of bean meal, 2 lb. bruised barley or oats, 10 to 12 lb. of cut hay, 14 lb. of straw chaff and some salt, being the ingredients of the cooked food. The whole, when mixed, is allowed to lie for some hours till the dry portions absorb the mucilage. Wherever it can be conveniently arranged, the animals should not be confined to one sort of food. To mingle the food judiciously benefits the beasts and saves the farmer money; for an animal will thrive better and cost less if fed on hay, turnips, and oil-cake, given in the proportions of one part cake, four parts hay, and seven parts turnips, than he would if suffered to eat the whole amount in one only of these ingredients.

Whatever articles of food may be given, they should be apportioned with as much regard to *regularity of time and quantity* as is practicable; and if a portion of it is at any time left unconsumed, it should be removed before the next meal, otherwise the beast will possibly refuse or loathe his food.

In stall-feeding it is too common a practice to give a certain allowance every day, without regard to circumstances; but it is well known that a fattening beast will eat with a keener appetite on a cold day than in warm, damp weather; and his food should be proportioned accordingly. By giving the same quantity every day, the animal may be cloyed. His appetite will become impaired, the food will be wasted, and several days will pass before he feeds heartily again. Three periods, at least, of the day, and as nearly equidistant as possible, should be selected as the feeding hours, when only such an allowance should be given to each animal as he can eat with good appetite. As he fattens, his appetite will probably become more delicate, and he will require more frequent feeding, and the food in smaller quantities; thus the beast will improve progressively and uniformly, while only a trifling quantity of the food will be lost. In proportion to the nutritive matter contained in the food, the animal will generally be found to improve; and in order that this important branch of rural economy may be

properly conducted, the young grazier will find it useful to weigh each beast once a fortnight, at the least, before he gives the morning allowance, by which he will be enabled to form an accurate estimate of the real progress his cattle are making. If they do not continue to advance according to the result of former weighing, it will be necessary to change their food. It will, perhaps, be satisfactory to weigh the cattle that are considerably advanced in the fattening process quite as often, or oftener than this. A more adequate idea of their thriving may thus be formed, and also the real profit and loss may be ascertained.

Of equal importance with regularity in feeding, is *cleanliness*, a point which is admitted by all intelligent breeders to be most essential to the health and thriving of the cattle. Animals, also, that are not at stall-feeding, should not only be supplied with plenty of pure water, but likewise, whenever they are brought home, either from pasture or work, their feet should be washed, lest any filth should remain about them, to soften and produce disease of the hoof. Frequent washing after hard labour—in the case of “yoke” wrought oxen,—or at least once in the week, should always take place; and though the practice of currying and combing, or of friction with brushes, cannot, perhaps be adopted where the beasts are numerous, yet it would be of considerable advantage if they were rubbed with a wisp of straw. The mangers and stalls should likewise be kept as clean as possible; and the former, if they cannot often be washed, should be cleared every morning from dust and filth, which may be easily effected by means of a common blunt-pointed bricklayer’s trowel. They otherwise acquire a sour and offensive smell from the decay of vegetable matter left in them, which will nauseate the cattle, and prevent their feeding.

It still remains a disputed point whether cattle thrive best in stalls whence the litter is removed and replaced by fresh straw every second or third day, or in boxes where it is suffered to remain for weeks, and only has fresh straw scattered over the surface. In the former case, it is evident that some of the most essential portion of the manure must inevitably be wasted, even supposing the manure heap to be well protected from rain; while in the latter, the whole is compacted into a solid mass of fertilizing matter. But under all circumstances a good and sufficient bed of litter is indispensable, especially during the winter season, and the farmer cannot be too careful of his straw if he would avoid being compelled to buy for the purpose of bedding his cattle.

It has been found that forty-five oxen, well littered, while fattening, with twenty waggon-loads of stubble, have made *two hundred loads*, each of *three* tons, of manure, the greatest and most valuable portion of which would have been lost, had it not been mixed with, and absorbed by, the straw. Every load of hay and litter, given to beasts fattening on oil-cake, yields at least ten tons of dung; and, on comparing the dung obtained by feeding on oil-cake with that of the common farm-yard, it has been found that the effects produced by spreading *one* load of the former on an acre considerably exceeded those of *two* loads of the latter. The value of the manure will in-

variably be found to be in proportion to the nutriment contained in the aliment. It is an old and a true proverb, "No food, no cattle; no cattle, no dung; no dung, no corn;" or, indeed, any other good crops.

The following Table, compiled from a paper dealing with "The Valuation of Unexhausted Manures," in which Dr. J. A. Voelcker and Mr. A. D. Hall review and revise the original tables of Sir John B. Lawes and Sir J. Henry Gilbert ("Journal of the Royal Agricultural Society," vol. lxiii., 1902, pp. 76-114), shows the manure-value supposed to be contributed by the consumption during the last year on the farm of a ton of each of the foods specified. The assumption is that half of the total original nitrogen of the food, three-fourths of the phosphate, and practically all the potash becomes usefully available; available nitrogen being taken at about  $6\frac{1}{2}d.$  per lb., phosphoric acid at a little over  $1\frac{1}{2}d.$  per lb., and potash at rather less than  $2\frac{1}{4}d.$  per lb. (For fuller details see pp. 1002 and 1003.)

TABLE showing the original value of the Manures obtained from the consumption of one ton of different Articles of Food, each supposed to be of good quality of its kind.

DESCRIPTION OF FOOD.		£	s.	d.	£	s.	d.
Linseed . . . . .		1	10	6	Locust beans . . . . .		12 2
Linseed-cake . . . . .		1	18	7	Malt combs . . . . .	1	15 11
Decorticated cotton-cake . . . . .		2	16	5	Bran . . . . .	1	8 11
Palm-nut cake . . . . .			19	8	Dried "grains" . . . . .	1	14 3
Undecorticated cotton-cake . . . . .		1	13	9	Wet "grains" . . . . .		6 0
Cocoa-nut cake . . . . .		1	11	6	Clover hay . . . . .	1	1 9
Rape-cake . . . . .		2	1	1	Meadow hay . . . . .		16 4
Peas . . . . .		1	7	4	Oat straw . . . . .		7 7
Beans . . . . .		1	11	8	Wheat straw . . . . .		6 5
Indian corn . . . . .			13	0	Barley straw . . . . .		6 9
Wheat . . . . .			14	10	Mangel : . . . .		3 1
Malt . . . . .			15	2	Swedish turnips . . . . .		2 6
Barley . . . . .			13	9	Turnips . . . . .		2 4
Oats . . . . .			15	5			
Rice meal . . . . .			14	3			

In connection with the subject of cattle-food, three points have been much discussed of late years—namely, the "cooking of food," the "puling of roots," and the use of "condimental foods."

With reference to the *cooking of food*, opinion continues pretty much divided as to its utility. That cooking possesses advantages inasmuch as it permits of making the most of the foods that are to be consumed is no doubt true; at the same time there is no experimental proof that the digestibility of the food stuffs is thereby increased. According to Sir John Lawes, experiments conducted in Germany have even shown decreased digestibility of hay to follow upon steaming. "Coarse hay fed to oxen, first dry, then steamed, showed a reduced digestibility of all the constituents, but especially of protein, which was reduced from 46 per cent. to 30. Boiled bran given to oxen was less digestible than dry bran. The digestibility of concentrated fodder is not increased by cooking." In some experiments in the feeding of pigs, it was found that



the animals did better on raw than on cooked potatoes when equal quantities, weighed in the raw state, were used.

The following is a statement of the results of experiments of Colonel McDoull, instituted with a view to decide the economy or otherwise of cooking food:—

“They showed, amongst other things, that one feed of cooked food per day, with two feeds of raw swedes, returned the most profit—more so than three feeds of raw swedes; but when two feeds of cooked food were given and only one feed of raw swedes, there was a loss. The food consumed daily by each animal, when two feeds of turnips and one feed of cooked food were given, was as follows:—‘84 lb. of swedes and one feed of cooked food at noon, consisting of 3 lb. cut straw, boiled along with 3 lb. of bean meal;’ the latter, the bean meal, being increased towards the conclusion of the experiment to 5 lb. daily. The same kind of cooked food was given to the lot, which was allowed two prepared feeds per day, but in this case the daily quantity of turnips consumed by each beast amounted only to 42 lb.”

The *pulping of roots*, of which we have already given a description, is of comparatively recent introduction. Its utility, as we have seen, is pretty generally admitted by some, although much has been stated in opposition to it by others. A very complete array of evidence as to the advantage of the system will be found in vol. xx. part 2, first series, of the “Journal of the Royal Agricultural Society of England.”

The use of *condimental foods* is a comparatively new feature of practical farming, and has given rise to a controversy which has not always been conducted with the calmness befitting an important scientific discussion. It is impossible, within the limits of the present volume, to go fully into all the details of the question. Much has been said and can be said on both sides, and space only permits us, of the “pro” and the “con,” to give the following. The leading disputants are the scientific and the practical men. The former, almost as a rule, argue against the use of these foods; the practical men are rather disposed to believe there may be “something” in their use; although, of course, many practical men are convinced of their inutility, while some men of science, on the contrary, think them beneficial.

The following is an opinion of Dr. Anderson, who was chemist to the Highland and Agricultural Society of Scotland. After referring to the character which was, upon their first introduction, claimed for them, that they were concentrated foods, containing in a very small bulk a large proportion of nutritive matter, and that of course small quantities might be used, Dr. Anderson says:—

“A minute examination of a number of them in the laboratory, has shown that there has been no attempt to concentrate in the sense in which that word is usually understood, for they all contain just as much water and woody fibre as other vegetable substances, and are, in fact, mixtures of the most ordinary materials, consisting of Indian corn, rice, bean-meal, ground carob beans, and other similar substances, along with small quantities of aromatic seeds, and in nine instances a bitter substance, apparently gentian. It is absurd

to suppose that the contents of a small tin measure holding about half-a-pint of these substances can be used to replace one-half of the ordinary food of an ox or a horse; and their inventors, seeing that as soon as these facts became known to the farmer their position would become untenable, have taken refuge behind the aromatics and bitters they contain, and have asserted that their effect is condimental, and that they act by promoting digestion, and causing the animal to extract and assimilate a larger quantity of the nutritive matters of its ordinary food. They have obviously gone upon the commonly-received opinion which attributes to salt and similar substances this effect—a view which the facts which I have already detailed by no means countenance. There is, in fact, not the slightest reason to suppose that the substances contained in these foods have any such effect. They consist, in addition to the grains already mentioned, chiefly of fenugreek and caraway seeds, and one of those I examined contained so large a quantity of turmeric that it might almost be described as a curry-powder. Nothing definite is known regarding the action of these substances on the system, there being no experiments such as those by which the effects of salt have been determined; and there is no evidence to support the view that they are capable of producing a more complete assimilation of the food, but every reason to believe the reverse. In fact, when a dispassionate view of the matter is taken, I think it can scarcely be doubted that, if small quantities of caraway or other aromatic seeds were given to animals, and their weights carefully determined, it would be found that they are quite without effect.

“It must be noticed that there have been no attempts on the part of the ‘discoverers’ to produce such accurate experiments in support of their views, although *there have been plenty of general testimonials, such as every quack medicine can produce by the score, and abundance of vague declamation regarding their wonderful effects.* The plain fact is, that science does not give the slightest support to the idea that these substances have any effect whatever, and in saying so I am only stating an opinion in which all chemists will concur, and which has, indeed, been often stated before. Its accuracy has just as often been denied by the makers of these articles, but it has never been disproved, nor will that be possible until they can produce the precise results of trustworthy experiments in support of their substances. But even admitting the accuracy of all the statements put forth by the makers of these foods, there is another question which merits attention, and that is the price at which they are sold. I have already mentioned that they are composed chiefly of some of the more familiar foods, mixed with a small quantity of aromatics. The exact proportion in which these latter substances exist in them cannot be accurately determined, but it is not large, and does not generally exceed 10 per cent. Indian corn, carob beans, &c., cost about 8*l.* or 9*l.* per ton, and fenugreek and caraway seeds about 20*l.* to 25*l.* A mixture of nine tons of the former and one of the latter should therefore be sold at 10*l.* or 11*l.* per ton, in place of 20*l.* or 30*l.*, the price actually charged; so that now, if these goods do produce the alleged effect, the farmer is made to pay for them three

times their intrinsic value. The fact is of itself a sufficient comment on what has been already stated, and *the truth is that the 'discoveries' of which the makers of these foods boast are confined to the art of extracting money from the pockets of the farmer.* The general conclusions to be drawn from what has been now said may be summed up in a very few words: 1st. Common salt, the most important condiment, has no effect in promoting the assimilation of the food, and, when used in larger quantity, has rather a tendency to produce a waste of nutritive matters. 2nd. Both it and phosphate of lime, and probably other mineral substances, may exercise a beneficial effect on health when the quantity existing in the food is less than the animal requires. 3rd. There is not the slightest reason to suppose that the so-called condimental foods produce any effect in the animal, as they consist only of ordinary grains mixed with small quantities of aromatic and bitter substances, which, so far as our present knowledge goes, do not in any way affect the nutrition of animals."

In so far as condiments are used to impart *flavour* to food they are undoubtedly serviceable. They then confer upon the food a quality which renders it more relished by live stock, and therefore more readily eaten. It is not easy to define what is meant by flavour: it is, indeed, so subtle a character that the balance of the chemist can give no record of it. Nevertheless, it is, in the hands of the skilful feeder, a factor too important to be neglected, and one which, rightly controlled, is productive of beneficial results.

Whatever may be advanced against the use of condimental foods from a purely scientific point of view—and that there may be, and is, much which can be so, must be admitted on a candid review of the whole of the statements made,—still facts must not be overlooked. And one fact is beyond all dispute—that the number of experienced practical farmers and breeders and feeders of the highest eminence who use these foods is on the increase. And this not after only occasional use of them, as if by way of mere tentative experiment, but after the steady persistent employment of them as part of the feeding materials used in the daily practice of the farm. Taking, then, a merely common-sense view of the matter, it is somewhat difficult to bring one's mind to believe that a class of men well known to be particularly careful, and said to be anything but open to the "allurements of new things," should not only continue to use these foods, but that the number who do use them is, as we have stated, on the increase. We have no desire to take a one-sided view—as we have no interest in doing so—of the matter. We have a simple plain duty to perform to our readers, and this is done by putting both sides of the question before them, leaving them to judge for themselves on the points at issue between the purely scientific and the purely practical man.

We cannot conclude this chapter without referring again to a condiment used in food which has an important influence in the health of stock; we refer to salt.

Some of our older readers, who can "go back a bit," may remember a pamphlet which was most extensively advertised under the curious

and catching title of "Salt, the Forbidden Fruit." What we have now to say on the subject is, that the belief of many stock-breeders seems

TABLE SHOWING THE AVERAGE COMPOSITION, PER CENT. AND PER TON, OF CATTLE FOODS.

Foods.	PER CENT.					PER TON.		
	Dry Matter.	Nitrogen.	Mineral Matter (Ash).	Phosphoric Acid.	Potash.	Nitrogen.	Phosphoric Acid.	Potash.
	per cent.	per cent.	per cent.	per cent.	per cent.	lb.	lb.	lb.
1. Linseed . . .	90·00	3·60	4·00	1·54	1·37	80·64	34·50	30·69
2. Linseed-cake . . .	88·50	4·75	6·50	2·00	1·40	106·40	44·80	31·36
3. Decorticated cotton-cake . . .	90·00	6·60	7·00	3·10	2·00	147·84	69·44	44·80
4. Palm-nut cake . . .	91·00	2·50	3·60	1·20	0·50	56·00	26·88	11·20
5. Undecorticated cotton-cake . . .	87·00	3·75	6·00	2·00	2·00	84·00	44·80	44·80
6. Cocoa-nut cake . . .	90·00	3·40	6·00	1·40	2·00	76·16	31·36	44·80
7. Rape-cake . . .	89·00	4·90	7·50	2·50	1·50	109·76	56·00	33·60
8. Peas . . .	85·00	3·60	2·50	0·85	0·96	80·64	19·04	21·50
9. Beans . . .	85·00	4·00	3·00	1·10	1·30	89·60	24·64	29·12
10. Lentils . . .	88·00	4·20	4·00	0·75	0·70	94·08	16·80	15·68
11. Tares (seed) . . .	84·00	4·20	2·50	0·80	0·80	94·08	17·92	17·92
12. Indian corn . . .	88·00	1·70	1·40	0·60	0·37	38·08	13·44	8·29
13. Wheat . . .	85·00	1·80	1·70	0·85	0·53	40·32	19·04	11·87
14. Malt . . .	94·00	1·70	2·50	0·80	0·50	38·08	17·92	11·20
15. Barley . . .	84·00	1·65	2·20	0·75	0·55	36·96	16·80	12·32
16. Oats . . .	86·00	2·00	2·80	0·60	0·50	44·80	13·44	11·20
17. Rice meal* . . .	90·00	1·90	7·50	(0·60)	(0·37)	42·56	(13·44)	(8·29)
18. Locust beans* . . .	85·00	1·20	2·50	...	...	26·88	...	...
19. Malt combs . . .	90·00	3·90	8·00	2·00	2·00	87·36	44·80	44·80
20. Fine pollard . . .	86·00	2·45	5·50	2·90	1·46	54·88	64·96	32·70
21. Coarse pollard . . .	86·00	2·50	6·40	3·50	1·50	56·00	78·40	33·60
22. Bran . . .	86·00	2·50	6·50	3·60	1·45	56·00	80·64	32·48
23. Clover hay . . .	83·00	2·40	7·00	0·57	1·50	53·76	12·77	33·60
24. Meadow hay . . .	84·00	1·50	6·50	0·40	1·60	33·60	8·96	35·84
25. Pea straw . . .	82·50	1·00	5·50	0·35	1·00	22·40	7·84	22·40
26. Oat straw . . .	83·00	0·50	5·50	0·24	1·00	11·20	5·38	22·40
27. Wheat straw . . .	84·00	0·45	5·00	0·24	0·80	10·08	5·38	17·92
28. Barley straw . . .	85·00	0·40	4·50	0·18	1·00	8·96	4·03	22·40
29. Bean straw . . .	82·50	0·90	5·00	0·30	1·00	20·16	6·72	22·40
30. Potatoes . . .	25·00	0·25	1·00	0·15	0·55	5·60	3·36	12·32
31. Carrots . . .	14·00	0·20	0·90	0·09	0·28	4·48	2·02	6·27
32. Parsnips . . .	16·00	0·22	1·00	0·19	0·36	4·93	4·26	8·06
33. Swedish turnips . . .	11·00	0·25	0·60	0·06	0·22	5·60	1·34	4·93
34. Mangel wurzels . . .	12·50	0·22	1·00	0·07	0·40	4·93	1·57	8·96
35. Yellow turnips* . . .	9·00	0·20	0·65	(0·06)	(0·22)	4·48	(1·34)	(4·93)
36. White turnips . . .	8·00	0·18	0·68	0·05	0·30	4·03	1·12	6·72

\* In the case of neither rice-meal, locust-beans, nor yellow turnips, have records of ash-analyses been found. For rice-meal the same percentages of phosphoric acid and potash as in Indian corn, and for yellow turnips the same as in swedes, are provisionally adopted; but in all cases the assumed results are given in parentheses. For locust beans no figure has been assumed, and the columns are left blank.

to be that, if not a fruit, salt is at least a substance which is forbidden in the creed of cattle-feeding—so rigidly is it kept out of all foods given to their stock. Perhaps they proceed upon the principle of a believer we knew of in the pamphlet we have above alluded to, that as all vegetable produce contained salt, each contained exactly the right proportions which nature intended to give to it; and that it was wrong to add more to it. Seriously, salt plays a most important part in the animal economy; and although it be true that if given in excess it may be injurious, at least may be made indirectly so by inducing a thirst which leads the animals to “drink more than is good for them,” that is no true or valid reason for not using it in proper quantity.

One thing alone would seem to point to the conclusion that salt is good for stock, namely, the very great liking they have for it—a liking so pronounced that it amounts in some (as for example horses) to almost a passion. We have known horses go back for weeks to an old trough, left by mistake in the fields, which had contained salt or salted food, and lick it by the hour, and that long after all flavour had apparently gone out of it. Sheep, especially lambs, will visit many times a day a lump of rock salt that happens to be accessible within the fold, and will obviously derive the greatest gratification from licking it. Now it is held to be a pretty good indication that substances of which the animals have a strong desire to partake agree with the animal economy, more especially if the desire steadfastly continues, and it is a wise and humane policy to leave salt within reach of all kinds of farm stock. On the prairies of the North-Western Territories of Canada may still be seen the well-trodden tracks or trails of the buffalo, or rather the bison, made by the immense herds of these creatures who used to pay periodical visits to the Salt Lakes.

Intimately related to the subject of feeding is that of the composition of feeding-stuffs. On the opposite page is presented a most valuable table, prepared by Sir John Lawes and Sir Henry Gilbert, which appeared in “The Journal of the Royal Agricultural Society,” vol. viii., 3rd series, 1897 (p. 695). It shows the average composition, per cent. and per ton, of thirty-six different foods; it gives the amount *per cent.* of dry matter, nitrogen, total mineral matter (ash), phosphoric acid, and potash, and the amounts *per ton* of the foods, of nitrogen, phosphoric acid, and potash. Whilst, however, these figures may be taken as representing the fair *average* composition of the different foods, they should be adopted or modified with judgment, having regard to the influence of the conditions of growth, maturity, preparation, or preservation, to which they have been subject.

## CHAPTER XIII.

## OF THE SALE OF CATTLE.

HAVING now stated the leading facts, and the experiments that have been made, on the subject of feeding and fattening neat cattle, we shall conclude this division with a few remarks on the *sale* of beasts, when properly prepared for that purpose. In order to ascertain this point, the following hints may, perhaps, afford some assistance. First, when the general appearance of the animal shows high condition, and each bone is covered with flesh in the manner required to constitute as perfect a degree of symmetry as can be attained by a thoroughly fat animal, it may be concluded that the beast is well fed; especially when his hip and huckle-bones are round, and his ribs, and flanks, and rump, and buttocks well filled up, and his scrotum or purse largely developed and round. The ends of the fingers should be pressed upon him in various parts, on the ribs, the hips, the rump, and the purse. If there is an evident elasticity of these parts, and they spring back when the fingers are removed, that mingled firmness and softness, well described by the term "mellowness," exists, and this is a sufficient assurance that the flesh is of thoroughly good quality. It is of consequence that this examination should take place; for animals which possess these qualities will alone find a sale in the metropolitan market, or possess that state of health which will enable them to support the journey they are soon to undertake.

After all the attention and labour, however, which the grazier may have bestowed, his expectations will, to a considerable degree, be disappointed, unless he selects a proper time for the disposal of his fat cattle. The most common season for beef is from Michaelmas to Christmas; but the markets are then more abundantly and more cheaply supplied than at any other period, because cattle that have been fattened on luxuriant pasture grounds are then ready for sale, and many farmers are under the necessity of raising money in order to meet the demands of the close of the year. Hence the attentive grazier, who has sufficient capital to hold his stock over, will find it most beneficial, at this time, to dispose only of such part of it as, being thoroughly fat, would not pay for longer keeping. The increase of prices in the spring will generally be found to remunerate him well. During the whole of December large heavy cattle are in much request at the Islington Metropolitan Cattle Market, and will produce remunerative prices; but at other times they hang on hand, and fetch an inferior price. Middle-sized handsome cattle, or those not exceeding seventy or eighty stones, will find the most ready sale. Under forty stones there is a prejudice against them, unless the meat is particularly good.

In drawing off lots of cattle for sale, it is the general practice to

dispose of the fattest animals, and to keep those which do not fatten kindly for additional feeding. As a general rule this is proper; but there will occasionally be exceptions to it. If the system which the grazier usually pursues involves the use of corn or oil-cake, or any other expensive article, or if there is a probability of an insufficient supply, and he is fully convinced that he has a beast that is not kindly disposed to take on fat, or is an *ill-doer*, the *first* loss is obviously the best, and he should dispose of the unthrifty animal at the earliest opportunity.

In the country, a mode of selling cattle by *lots* for slaughter is sometimes adopted. In this case, in order to prevent dispute between the parties, care should be taken to fix the precise time in which any particular lot is to be drawn, in order that no unnecessary food may be consumed. It is a proceeding which gives a manifest advantage to one of the parties; for the farmer, unless he has been accustomed to weigh his beasts during the progressive states of their fattening, can only have a very uncertain idea of their weight; while the butcher, from his continual practice, is enabled to form a tolerably accurate estimate. Hence some have killed a beast out of a particular lot, with a view to ascertain the average weight of animals in such lot; but, in order to obtain a perfect equality between the buyer and seller, it would be better to dispose of every beast by weight, and that can be easily ascertained by the steelyard.

There are two ways of ascertaining what is called the "carcass" weight,—by weighing the animal in the weighing machine, and by measurement. The "carcass" weight means the weight of the animal when dressed for sale, the "offal" being cast out of the reckoning. The offal consists of the head and shanks, the "hide," the "fat" or "tallow," "entrails," and "stomach," with the blood. The proportion which the "carcass" weight of the animal when cut up for the shambles bears to the full weight of the animal when alive is estimated by eminent authorities to be 60 per cent. Much, however, depends (*see* page 193) upon varying circumstances of breed, constitution, and age. In the Shorthorn breed, steers of 150 stones, 14 lb. to the stone, yield on an average 68 to 70 per cent. of beef of the live weight; of 100 to 120 stones, 64 to 68; and of 70 to 90 stones, 55 to 60. The mode of ascertaining the carcass weight by measurement is as follows:—

The farmer passes a string round the beast just behind the shoulder-blade, and then measures the length of that string. This is, in simple language, taking the girth of the animal, and he writes it down. Next, from that bone of the tail whence a line would fall perpendicularly, just touching the buttock, he measures along the back to the fore part of the shoulder blade, and he registers the amount of this.

He has now the girth and the length of the beast. He multiplies them together, and he has the number of square superficial feet which the exterior of the beast comprises. He next multiplies the product of this by twenty-three—the number of pounds allowed to each superficial foot in all cattle measuring less than seven and more than five feet in

girth, and he obtains the amount, let us suppose, of 713 pounds, which, allowing fourteen pounds to the stone, is fifty stones thirteen pounds, or, according to the old computation of eight pounds, eighty-nine stones and one pound.

Suppose the animal weighed to be less than nine and more than seven feet in girth, thirty-one is the number of pounds allowed to each superficial foot, and under five feet, eleven pounds. For a half-fatted beast, one stone in twenty must be allowed, and one stone in the whole weight for a cow that has had calves.<sup>1</sup> Another rule is to multiply the square of the girth by three times the length, and divide the product by 21, the result indicating the weight in stones of fourteen pounds.

With regard to *fat calves*, we should observe that, in general, by weighing the animal alive at the time of sale, and from the gross weight deducting eight pounds from every score to be allowed to the butcher, the remainder will be equal to the weight of the four quarters. Thus, if a farmer wishes to ascertain the value of a calf at 8*d.* per pound—properly securing him so as not to do him any injury—he weighs him with scales or a steelyard, or in a weighing machine, and perhaps finds the weight to be ten score, or 200 lb. From this he deducts eighty pounds, or eight pounds from each score, and the remainder, 120 lb., will be very nearly the weight of the four quarters; and this, at 8*d.* per pound, will be 4*l.* As this rule will not, in general, vary more than four ounces or half a pound, in a quarter or side, it will be found to answer sufficiently well for general use.

A very useful handbook,<sup>2</sup> which every grazier should possess and use, was prepared by Sir J. B. Lawes in 1888. It is intended as a practical guide and help to those who consider that grazing stock may with advantage be bought as stores, and sold out fat, on the basis of live weight. We quote from the author's "Explanations":—"Store cattle contain about 50 per cent., or, if fresh, rather more, of carcass. They may be considered well and cheaply purchased if the carcass does not cost more per lb. than the carcass of a fat animal. For instance, if I am selling my fat stock at 6*d.* per lb. of carcass weight, I should consider that I was purchasing store cattle reasonably cheap if I could obtain them for 3*s.* 6*d.* per stone of 14 lb. *live weight*, or even 4*s.* if they were fresh. Generally speaking the carcass of a store animal costs rather more per lb. than that of a fat animal; but frequently the price given for store stock is so high as to cause a serious loss on the fat animal. Purchasing by live weight will tend to obviate this.

"By the use of the scales the farmer is at once put in possession of that knowledge which has been acquired by salesmen and butchers from years of experience. I myself can form no opinion as to the

<sup>1</sup> For ascertaining the weight of cattle, we know of few more useful manuals than Renton's "Grazier's Ready Reckoner," a small pamphlet consisting of tables calculated to determine the weight of any animal within certain limits, sinking the offal; and accompanied with rules for taking such measurement.

<sup>2</sup> "Tables for estimating Dead Weight and Value of Cattle from Live Weight." By Sir J. B. Lawes, Bart. Published at the offices of the Royal Agricultural Society of England, 13, Hanover Square, London, W. Price 1*s.*



weight of the carcass of an animal by handling it; but let me see it, and place it upon the scales, and I can form as correct an opinion in regard to the weight of the carcass as the most experienced salesman. Long experience in weighing stock satisfies me that the farmer rarely obtains for his fat stock their value according to the prices quoted in the papers; he either receives less per stone, or he receives for less stones than the animals weigh."

The "Pocket Ready Reckoner," by Mr. T. H. Thursfield, of Barrow, Broseley, Shropshire, is also useful for the same purpose.

Nothing could better illustrate the need of the weighing machine than the case given by Mr. Albert Pell, in his paper on weighing live-stock, published in "The Journal of the Royal Agricultural Society," vol. xxv., second series (1889). "It so happened," says Mr. Pell, "that the experiments conducted by the Royal Agricultural Society of England at Woburn furnished an opportunity of great practical value at that time for forming a comparison between the judgment of five experienced feeders of cattle and the statical authority of the scales. Dr. Voelcker, having charge of the feeding experiments at Woburn, invited these five gentlemen to estimate the carcass-weight of eight of the experimental beasts he was about to weigh. It should not be forgotten that the amount and character of the food consumed, the period of fattening, and the treatment of these animals down to the nicest details were furnished to the guessers. There seems to have been nothing wanting to render the guesses oracular except the gift of divination. That this certainly was not vouchsafed will be gathered from the Table on the following page.

The cattle of the farmer, unless he resides at a very great distance, are usually sent to the metropolitan market for sale. A few years ago they were always driven the whole distance; and many an accident, with occasionally loss of life, and the certain diminution of weight to a very considerable extent, was the result. Now, conveyance by railway greatly obviates this disadvantage.

Some preparation should always be made for the commencement of the journey, where the animals have to be driven far. Their food should undergo some change. The green food should be diminished, and the dry food increased, in order to prevent diarrhœa on the road. They should be loosened from their stalls a short time twice in the day, for the two or three days previous to their setting out, in order to accustom them a little to exercise, and prevent that giddiness by which they would probably be attacked after being so long confined, and also to prevent any of the dangerous pranks which they may be inclined to play upon the road. That farmer would be wise who put them in the trevis and had them shod, for where the journey on foot is long several of almost every large herd are usually left behind, and become expensive, or are sold to great disadvantage, on account of their hoofs being worn through by the roughness of the roads. They should start slowly, and during the first two or three days should not be driven more than seven or eight miles per day. In winter they should be put into an open court or shed at night, and in summer turned into some pasture. Gradually the day's journey may be increased to twelve or fourteen

**WOBURN FEEDING EXPERIMENTS.**  
**FARMERS' ESTIMATED WEIGHT COMPARED WITH ACTUAL WEIGHT.**

Bullock.	Farmer.	Farmer's estimated carcass-weight in 8lb. stones.		Actual weight in 8lb. stones.		Difference, 8lb. stones.	
		st.	lb.	st.	lb.	st.	lb.
No. 1	A.	99	6	106	6	7	0 under
	B.	96	0	"	"	10	6 "
	C.	98	0	"	"	8	6 "
	D.	92	4	"	"	14	2 "
	E.	104	0	"	"	2	6 "
No. 2	A.	101	4	104	6	3	2 under
	B.	100	0	"	"	4	6 "
	C.	101	4	"	"	3	2 "
	D.	95	0	"	"	9	6 "
	E.	110	0	"	"	5	2 over
No. 3	A.	98	0	103	7	5	7 under
	B.	98	0	"	"	5	7 "
	C.	98	0	"	"	5	7 "
	D.	95	0	"	"	8	7 "
	E.	105	0	"	"	1	1 over
No. 4	A.	95	3	93	7	1	4 over
	B.	94	0	"	"	0	1 "
	C.	91	0	"	"	2	7 under
	D.	87	4	"	"	6	3 "
	E.	98	0	"	"	4	1 over
No. 5	A.	98	0	93	0	5	0 over
	B.	95	0	"	"	2	0 "
	C.	99	6	"	"	6	6 "
	D.	92	4	"	"	0	4 under
	E.	96	0	"	"	3	0 over
No. 6	A.	100	5	102	0	1	3 under
	B.	100	0	"	"	2	0 "
	C.	96	2	"	"	5	6 "
	D.	95	0	"	"	7	0 "
	E.	107	0	"	"	5	0 over
No. 7	A.	92	6	98	1	5	3 under
	B.	90	0	"	"	8	1 "
	C.	89	2	"	"	8	7 "
	D.	87	4	"	"	10	5 "
	E.	88	0	"	"	10	1 "
No. 8	A.	98	0	105	2	7	2 under
	B.	97	0	"	"	8	2 "
	C.	98	0	"	"	7	2 "
	D.	95	0	"	"	10	2 "
	E.	96	0	"	"	9	2 "

Of 40 estimates, 30 were under and 10 over the actual weights.

**DIFFERENCE BETWEEN FARMERS' HIGHEST AND LOWEST ESTIMATES IN 8LB. STONES.**

Bullock	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.
	st. lb.	st. lb.	st. lb.	st. lb.	st. lb.	st. lb.	st. lb.	st. lb.
Highest	104 0	110 0	105 0	98 0	99 6	107 0	92 6	98 0
Lowest	92 4	95 0	95 0	87 4	92 4	95 0	87 4	95 0
Difference	11 4	15 0	10 0	10 4	7 2	12 0	5 2	3 0

miles, but it will be dangerous to extend it beyond that distance. Plenty of time should be allowed for its completion; for if the cattle are hurried on the road, even although they do not exceed the number of miles just mentioned, they will be distressed and off their feed, and the foundation may be laid for serious disease. It is scarcely credible how different will often be the state of droves that have performed their journey in the same number of days. There will be a stone difference in the weight of each beast, and double the value of that in the quality of the meat. It is impossible to estimate the extent of the mischief when cattle have been over-driven, and he who is acquainted with them will be very cautious how he purchases animals having that appearance.

The principal objection to sending cattle alive in ships is that they are necessarily confined in small spaces, and are liable to be bruised and to lose condition. In the long ocean voyages, however, the arrangements are well carried out, and it is surprising how little harm the cattle suffer. But in rough weather it not uncommonly happens that they have to be thrown overboard, to lighten the deck cargo, and the writer has seen carcasses of fine animals floating on the billows of the Atlantic.

In railway trucks the cattle are sometimes bruised a good deal; but a great improvement in recent years has been effected, and now they arrive as a rule in good condition, and fit for slaughter at once. Probably the following words, which appeared in the twelfth Edition of this work, had something to do with the improvement, and we leave them again on record:—

“At the same time it should be remembered that every day the evils connected with the transport of cattle by railway are increasing. Grave fault, indeed, is to be found with railway management in this respect. Cattle are put into dirty trucks containing the dung, perhaps, of diseased animals which have been previously carried; they are knocked grievously about during the process of ‘shunting,’ which takes place very frequently during a long journey, and which process is most carelessly performed. The cattle are exposed in the open trucks, at sidings and stations, and subjected as well to the horrors of thirst and hunger as to cold and wet. On principles of humanity as well as business policy, a change of all this is imperatively demanded. We are glad to see the agricultural public becoming daily more alive to the importance of railway managers carrying out a more humane and more economical system of cattle transport.”

The cattle and sheep having reached the metropolis are consigned to a salesman for disposal. He is a middle-man between the farmer and the butcher, who disposes of the cattle to the best advantage, and at a moderate charge. He has to pay to the banker and money-taker certain dues.

Mr. Hillyard, who used for some years to sell his own stall-fed beasts in Smithfield, thus speaks of the salesman:—“The amount of the graziers’ or stall-feeders’ profit much depends on the salesmen they employ. Theirs is an office of great trust and confidence; and,

in justice to those employed in this part of the country, or, in fact, in any other part that I am acquainted with, I must say that I never heard any untrue return made of the prices that beasts or sheep have sold for. Salesmen, from being regularly in the market, must be good judges of the weight and quality of the meat of the beasts or sheep they have to sell for their employers. Besides having good judgment, a Smithfield salesman ought to be a man of good temper, to bear the great undervalue biddings of some of the butchers in an overstocked market. He ought to have capacity to form a quick and correct judgment, when, from the state of the market to give way in the prices he has asked, and when to be firm; and he ought at no time to spare either pains or trouble to do the best in his power for those who employ him. I am quite satisfied that a clever painstaking salesman, who regularly attends the market, can on the whole, make more of graziers' and stall-feeders' beasts than they themselves can, provided he has not too large droves. Objections, however, are reasonably and fairly made to those who are in the habit of jobbing."

TABLE FOR THE EQUALISATION OF DIFFERENT WEIGHTS.

Scores.	Stones at 14 lb.	Stones at 8 lb.	Scotch stones, 16 lb.	Hundreds, 112 lb.
	st. lb.	st. lb.	st. lb.	cwt. qrs. lb.
20 equal	28 8	50 0	25 0	3 2 8
25 "	35 10	62 4	31 2	4 1 24
30 "	42 12	75 0	37 4	5 1 12
35 "	50 0	87 4	43 6	6 1 0
40 "	57 2	100 0	50 0	7 0 16
45 "	64 4	112 4	56 2	8 0 4
50 "	71 6	125 0	62 4	8 3 20
55 "	78 8	137 4	68 6	9 3 8
60 "	85 10	150 0	75 0	10 2 24
65 "	92 12	162 4	81 2	11 2 12
70 "	100 0	175 0	87 4	12 2 0
75 "	107 2	187 4	93 6	13 1 16
80 "	114 4	200 0	100 0	14 1 4

The weights *per stone*, commonly used for cattle in different parts of the kingdom, are as follow, viz. :—

<i>Smithfield</i> . . . . .	8 lb. of 16 oz. each.
<i>North Country</i> . . . . .	14 lb. ,,
<i>Common Scotch</i> . . . . .	16 lb. ,,

<i>Glasgow Tron</i> . . . . .	16 lb. of 22 oz. each.
<i>Ayrshire</i> . . . . .	16 lb. of 24 ,,
<i>Dutch</i> . . . . .	16 lb. of 17½ ,,

Of these, the stone of 14 lb. is chiefly used in calculating live weight, and that of 8 lb. for the carcass.

A great deal of dead meat is brought by railways from different parts of the kingdom, as well as by the steamers from both the eastern and western coasts, and from Scotland and Ireland. A hint or two may be of service to those who send it. The sheep should be slaughtered and dressed with all the attention to cleanliness that is found in a London

TABLE OF PRICES.

PER SCORE OF 20LB.—THE DIFFERENCE BEING CALCULATED AT ONE FARTHING PER LB.

Scores at	3½d.		4d.		4¼d.		4½d.		5d.		5¼d.		5½d.		6d.		6¼d.		6½d.		6¾d.		7d.		Difference.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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N.B.—One-half, as above, is .	...		2¼d.		...		2½d.		...		2¾d.		...		3d.		...		3¼d.		...		3½d.		...		3¾d.		...		4d.		...		4¼d.		...		4½d.		...		4¾d.		...		5d.		...		5¼d.		...		5½d.		...		6d.		...		6¼d.		...		6½d.		...		6¾d.		...		7d.		...		7¼d.		...		7½d.		...		7¾d.		...		8d.		...		8¼d.		...		8½d.		...		8¾d.		...		9d.		...		9¼d.		...		9½d.		...		9¾d.		...		10d.		...		10¼d.		...		10½d.		...		10¾d.		...		11d.		...		11¼d.		...		11½d.		...		11¾d.		...		12d.		...		12¼d.		...		12½d.		...		12¾d.		...		13d.		...		13¼d.		...		13½d.		...		13¾d.		...		14d.		...		14¼d.		...		14½d.		...		14¾d.		...		15d.		...		15¼d.		...		15½d.		...		15¾d.		...		16d.		...		16¼d.		...		16½d.		...		16¾d.		...		17d.		...		17¼d.		...		17½d.		...		17¾d.		...		18d.		...		18¼d.		...		18½d.		...		18¾d.		...		19d.		...		19¼d.		...		19½d.		...		19¾d.		...		20d.		...		20¼d.		...		20½d.		...		20¾d.		...		21d.		...		21¼d.		...		21½d.		...		21¾d.		...		22d.		...		22¼d.		...		22½d.		...		22¾d.		...		23d.		...		23¼d.		...		23½d.		...		23¾d.		...		24d.		...		24¼d.		...		24½d.		...		24¾d.		...		25d.		...		25¼d.		...		25½d.		...		25¾d.		...		26d.		...		26¼d.		...		26½d.		...		26¾d.		...		27d.		...		27¼d.		...		27½d.		...		27¾d.		...		28d.		...		28¼d.		...		28½d.		...		28¾d.		...		29d.		...		29¼d.		...		29½d.		...		29¾d.		...		30d.		...		30¼d.		...		30½d.		...		30¾d.		...		31d.		...		31¼d.		...		31½d.		...		31¾d.		...		32d.		...		32¼d.		...		32½d.		...		32¾d.		...		33d.		...		33¼d.		...		33½d.		...		33¾d.		...		34d.		...		34¼d.		...		34½d.		...		34¾d.		...		35d.		...		35¼d.		...		35½d.		...		35¾d.		...		36d.		...		36¼d.		...		36½d.		...		36¾d.		...		37d.		...		37¼d.		...		37½d.		...		37¾d.		...		38d.		...		38¼d.		...		38½d.		...		38¾d.		...		39d.		...		39¼d.		...		39½d.		...		39¾d.		...		40d.		...		40¼d.		...		40½d.		...		40¾d.		...		41d.		...		41¼d.		...		41½d.		...		41¾d.		...		42d.		...		42¼d.		...		42½d.		...		42¾d.		...		43d.		...		43¼d.		...		43½d.		...		43¾d.		...		44d.		...		44¼d.		...		44½d.		...		44¾d.		...		45d.		...		45¼d.		...		45½d.		...		45¾d.		...		46d.		...		46¼d.		...		46½d.		...		46¾d.		...		47d.		...		47¼d.		...		47½d.		...		47¾d.		...		48d.		...		48¼d.		...		48½d.		...		48¾d.		...		49d.		...		49¼d.		...		49½d.		...		49¾d.		...		50d.		...		50¼d.		...		50½d.		...		50¾d.		...		51d.		...		51¼d.		...		51½d.		...		51¾d.		...		52d.		...		52¼d.		...		52½d.		...		52¾d.		...		53d.		...		53¼d.		...		53½d.		...		53¾d.		...		54d.		...		54¼d.		...		54½d.		...		54¾d.		...		55d.		...		55¼d.		...		55½d.		...		55¾d.		...		56d.		...		56¼d.		...		56½d.		...		56¾d.		...		57	

slaughter-house. This is not so much regarded as it ought to be. The carcass of the sheep usually comes whole, but that of the ox is too often sadly disfigured. The meat is not packed in so cleanly a manner as it ought to be, nor has it been suffered to hang until the muscles and the fat become set. Mutton should hang eighteen hours, and beef thirty before being sent away. Imports of live animals for meat have been greatly reduced in number since sanitary restrictions have prohibited their receipt from any country in which rinderpest, pleuropneumonia, or foot-and-mouth disease exists, and as hardly any European country is free from all these diseases, and Argentina was scheduled a few years ago, our imports are almost exclusively from the United States and Canada, and from these countries only for slaughter at the ports of landing.

The dead-meat trade from these countries was commenced in 1874 by a consignment of twelve tons, arrangements for the receipt and disposal of which were made by Mr. John Dyke, of Liverpool. The trade in live cattle was started the year before, by Messrs. John Bell & Sons, of Glasgow.<sup>1</sup> The Transatlantic live and dead meat trade has had a profound influence over the conditions of grazing and fattening cattle in Great Britain, and the course of the markets at any given period of the year cannot now be depended upon at all, for whenever markets on this side begin to improve, the Americans and Canadians send forward their beef; and when prices decline, they simply diminish their consignments; so that in reality the English markets are to a great extent governed from the other side of the Atlantic. This is a state of things with which the farmers of the British Islands will have to reckon for some time to come; and not in reference to North America only, but also to the vast grazing regions in the southern half of the great Continent of the West.

There are more favourable points connected with the "dead meat" system. In this there is no offal—at least if this was brought over at all, it would be simply bought and sold as such,—it takes up much less space, requires no attention like live animals; and the system upon which it is transported seems to be so effectual that it is in as good condition nearly—in many respects better when compared with some meat exposed for sale—as where the animals are bred and fed in this country. The system by which the meat is preserved during the voyage is very simple, and consists in merely packing or placing the carcasses in chambers specially prepared and placed in convenient situations in the hold of the ship. Into these chambers air artificially cooled is introduced, and, circulating and remaining amongst the interstices of the meat, keeps it fresh and cool for a considerable length of time. It was, we believe, to Professor Gamgee that the public were indebted for this system, which of all those yet introduced offers, we imagine, the greatest chances of ultimate success, and is preferable either to the freezing or canning of meat. At present, however, the mere chilling of meat has not proved sufficient to preserve safely what comes from the Antipodes, and this is frozen.

<sup>1</sup> See "Report on the American and Canadian Meat Trade," by J. P. Sheldon, in the "Journal of the Royal Agricultural Society," vol. xiii. p. 295, 2nd series (1877).

Our imports of live animals for food have been greatly reduced in the last thirty years. In 1890 we imported 642,596 cattle, as compared with 472,015 in 1907. The former quantity was the maximum for any year. Sheep came most numerously in 1882, when the number was 1,124,391, and over a million arrived in 1886, and not far short of a million in 1887; but in 1907 only the insignificant number of 105,601 came to us from foreign and colonial sources. The live pig trade was never an important one. The greatest number of pigs imported in any year was 133,280 in 1865, and in recent years sanitary restrictions have shut these animals out altogether. There is no need of them, as the home supply is ample to meet the comparatively small demand for fresh pork, while foreigners find it suits them well to supply our markets with bacon and hams.

But while our imports of live meat have been greatly reduced, those of dead meat have increased enormously in the last thirty years. In 1887 the total of all kinds was only 6,573,866 cwt., whereas in 1907 it was 19,458,098 cwt., showing nearly a three-fold increase.

A convenient compilation has appeared annually in the "Live Stock Journal" for the last eighteen years, showing not only the imports of live and dead meat, but also those of other kinds of animal food, the corresponding exports, and the values of the imports and exports.

The tables for 1906 and 1907 are of interest as showing the quantities and values of the several classes of animal food imports, and the estimated dead weights of animals imported alive, while the summaries for eighteen years show in a striking manner the vast increase that has taken place in our supplies of such food from outside sources.

## TWO YEARS' ANIMAL FOOD IMPORTS.

	1906.	1907.	Increase or decrease.
Cattle . . . Number	561,215	472,015	- 89,200
Sheep . . . "	103,359	105,601	+ 2,242
Beef, fresh . . . Cwt.	5,523,809	5,735,003	+ 211,194
" salt . . . "	161,363	138,346	- 23,017
Mutton . . . "	4,082,756	4,592,142	+ 509,386
Pork, fresh . . . "	492,121	567,332	+ 75,211
" salt . . . "	206,056	254,637	+ 48,581
Bacon . . . "	5,542,622	5,365,605	- 177,017
Hams . . . "	1,302,752	1,132,649	- 170,103
Meat, preserved . . . "	487,424	316,517	- 170,917
" unenumerated . . . "	662,954	652,363	- 10,591
Rabbits . . . "	803,556	692,923	- 110,633
*Total dead meat . . . "	19,254,822	19,458,098	+ 203,276
Butter . . . . . "	4,337,258	4,216,435	- 120,823
Margarine . . . . . "	1,101,957	885,068	- 216,889
Cheese . . . . . "	2,638,794	2,372,235	- 266,559
Condensed milk † . . . . . "	911,876	907,903	+ 3,973
Lard . . . . . "	2,049,376	1,965,131	- 84,236
Eggs . . . . . Great hundreds	18,874,059	18,566,891	- 306,168
Poultry and game . . . . .	£985,457	£1,057,933	+ £72,474

\* Except poultry and game, returned only in value.

† Fresh milk and cream are not enumerated in the monthly returns.

"The decrease in cattle is due to shortness in supplies from the United States and Canada, while the small increase in sheep is likewise due to those countries. No pigs were imported in 1907, or 1906, though a small lot arrived in 1905. The number of decreases in dead meat items is even greater than it was for 1906; but it will be seen that the increases overbalance them in quantity, making the total of dead meat greater than it was in that year, a 'record' one up to its date. Fresh beef and mutton both reached the maximum in 1907; but they are the only single items in the table that did so. Both have increased almost regularly for a long time, the growth of mutton imports having been checked only twice in twenty-three years. The latter item shows by far the greatest increase appearing in the last column. Rabbits had increased annually for fourteen years up to 1906, but have now fallen off considerably. The decline in butter has taken place in spite of increases from Russia, Denmark, Sweden, New Zealand, and Australia, supplies from the United States having become quite insignificant last year, and those from Canada small. Fluctuations in cheese are so common that they do not call for much notice, though it may be worth while to point out that Canada and the United States are accountable for the decrease in 1907. Denmark, Belgium, and France share in the unusual decline in eggs.

"In converting cattle and sheep into their equivalents in dead meat, the usual plan of allowing ninety stones of 8 lb. for cattle, sixteen for calves, and seven and a half for sheep has been followed, while the proportion of calves to full-grown cattle is assumed to have been the same as it was on the average in the last three years in which calves were separately enumerated:—

## LIVE AND DEAD MEAT IMPORTS.

	1906.	1907.	Increase or decrease.
	Cwt.	Cwt.	Cwt.
Dead weight of cattle . . .	3,458,592	2,884,706	- 573,886
Dead weight of sheep . . .	55,371	56,500	+ 1,129
Total of live meat . . .	3,513,963	2,941,206	- 572,757
Total of dead meat . . .	19,254,822	19,458,098	+ 203,276
Grand total . . .	22,768,785	22,399,304	- 369,481

"The totals are given in the next table for the eighteen years for which this compilation has been made.



Years.	Dead weight of live meat.	Dead meat.	Total meat.	Years.	Dead weight of live meat.	Dead meat.	Total meat.
	Cwt.	Cwt.	Cwt.		Cwt.	Cwt.	Cwt.
1890	4,039,000	10,068,239	14,107,239	1899	3,560,883	17,158,490	21,219,373
1891	3,239,472	9,893,895	13,133,367	1900	3,386,861	17,911,738	21,298,599
1892	3,269,998	10,607,672	13,877,670	1901	3,390,153	18,764,431	22,154,581
1893	2,221,569	9,408,487	11,630,056	1902	2,852,453	16,971,022	19,823,475
1894	3,315,310	10,718,870	14,034,180	1903	3,548,606	17,498,127	21,046,733
1895	3,240,771	12,097,716	15,338,487	1904	3,735,738	17,517,486	21,253,224
1896	4,027,613	13,518,095	17,545,708	1905	3,729,475	18,679,406	22,408,881
1897	4,301,070	15,005,176	19,306,246	1906	3,513,963	19,254,822	22,768,785
1898	4,012,898	16,445,295	20,458,193	1907	2,941,206	19,458,098	22,399,304

“The grand total for 1906 was the greatest ever recorded; but for 1907 there is a decline of 396,481 cwt.

EXPORTS OF CATTLE, SHEEP, PIGS, AND ANIMAL FOOD.

	1906.	1907.	Increase or decrease.
Cattle . . . Number	5,616	5,066	- 550
Sheep . . . „	12,716	9,973	- 2,779
Pigs . . . „	2,221	1,357	- 864
Undistinguished animals for food . . . Cwt.	75	77	+ 2
Meat . . . „	477,628	492,374	+ 14,746
Butter . . . „	90,470	95,894	+ 5,424
Margarine . . . „	9,847	8,847	- 1,000
Cheese . . . „	65,014	62,194	- 2,820
Condensed milk . . . „	74,905	34,958	- 39,947
Lard . . . „	201,820	174,614	- 27,206
Provisions . . . „	658,539	611,040	- 47,499
Poultry and game . . .	£91,014	£103,537	+ £12,523

“Most of the exports show decreases. Those of cattle, sheep, and provisions are all of home production, while undistinguished animals and condensed milk are all re-exports, and the other items are made up of home and foreign and Colonial products together.

“The values of the imports given in the first table are next set forth:—

VALUES OF ANIMAL FOOD IMPORTS.

	1906.	1907.	Increase or decrease.
	£	£	£
Cattle . . . . .	9,732,180	8,105,109	- 1,627,071
Sheep . . . . .	156,947	168,531	+ 11,584
Total live meat . . .	9,889,127	8,273,640	- 1,615,487

VALUES OF ANIMAL FOOD IMPORTS—*continued.*

	1906.	1907.	Increase or decrease.
	£	£	£
Beef, fresh . . . . .	9,785,607	10,397,102	+ 611,495
„ salt . . . . .	217,947	201,222	- 16,725
Mutton . . . . .	7,645,935	8,711,931	+ 1,065,996
Pork, fresh . . . . .	1,130,950	1,338,242	+ 207,292
„ salt . . . . .	266,800	328,369	+ 61,569
Bacon . . . . .	14,644,115	14,839,201	+ 195,086
Hams . . . . .	3,491,594	3,242,183	- 249,411
Meat, preserved	1,822,671	1,534,915	- 287,756
„ unenumerated . . . . .	1,145,464	1,129,267	- 16,197
Rabbits . . . . .	1,000,786	862,735	- 138,051
Poultry and game . . . . .	985,457	1,057,933	+ 72,476
Total dead meat . . . . .	42,137,326	43,643,100	+ 1,505,774
Butter . . . . .	23,460,196	22,452,460	- 1,007,736
Margarine . . . . .	2,733,795	2,223,645	- 510,150
Cheese . . . . .	7,607,641	6,905,512	- 702,129
Condensed milk . . . . .	1,563,677	1,599,637	+ 35,960
*Total dairy produce . . . . .	35,365,109	23,181,254	- 2,183,855
Lard . . . . .	4,361,399	4,491,539	+ 130,140
Eggs . . . . .	7,098,122	7,134,532	+ 36,410
Grand total . . . . .	98,851,083	96,724,065	- 3,127,018

\* Except fresh milk and cream, not given in the monthly returns.

“Three items which decreased in quantity, namely, bacon, lard, and eggs, increased in value. The augmentation in the value of mutton is very great, and that relating to beef is considerable.

The values of the corresponding exports are next shown :—

## VALUES OF EXPORTS OF CATTLE, SHEEP, PIGS, AND ANIMAL FOOD.

	1906.	1907.	Increase or decrease.
	£	£	£
Cattle . . . . .	327,335	227,316	- 100,019
Sheep . . . . .	204,061	134,620	- 70,441
Pigs . . . . .	20,292	11,059	- 9,233
Undistinguished animals for food . . . . .	1,960	1,776	- 184
Meat . . . . .	1,194,283	1,660,345	+ 466,062
Butter . . . . .	465,452	487,217	+ 21,765
Margarine . . . . .	23,908	21,211	- 2,697
Cheese . . . . .	219,251	213,483	- 5,768
Lard . . . . .	425,972	405,896	- 19,896
*Provisions . . . . .	658,539	611,040	- 47,499
Poultry and game . . . . .	91,014	103,537	+ 12,523
Totals . . . . .	3,631,887	3,877,500	+ 245,613

\* It is impossible to tell to what extent these include animal food.

“Deducting these totals from those of gross imports, we have the values of net imports :—

	1906.	1907.	Increase or decrease.
	£	£	£
Gross imports of animal food . . . . .	98,851,083	96,724,065	- 2,127,018
Corresponding exports . . . . .	3,631,887	3,877,500	+ 245,613
Net imports . . . . .	95,219,196	92,846,565	- 2,372,631

Finally, the value of gross and net imports of animal food are given for eighteen years :—

Years.	Gross.	Net.	Years.	Gross.	Net.
	£	£		£	£
1890	57,362,959	54,365,364	1899	77,770,921	73,998,512
1891	55,958,143	53,326,180	1900	83,951,999	80,293,682
1892	60,347,530	58,278,996	1901	89,764,960	85,666,236
1893	58,526,584	56,895,403	1902	89,892,947	86,127,825
1894	61,896,186	59,454,848	1903	92,791,752	89,354,999
1895	62,847,577	60,070,886	1904	89,803,068	86,355,688
1896	66,263,079	63,068,476	1905	92,163,444	88,355,885
1897	71,516,089	68,418,300	1906	98,851,083	95,219,106
1898	73,100,786	69,277,062	1907	96,724,065	92,846,565

“These figures show a considerable falling-off in the values of gross and net imports as compared with the maxima of 1906.”

The table on page 238, compiled by Messrs. Weddell & Co., of London, dealing with frozen mutton and lamb (in carcasses) imported into the United Kingdom since the trade commenced, summarises the principal sources of supply and the leading ports of delivery :—

Year.	Australia.		New Zealand.		River Plate, Uruguay, &c.			Other countries.		Totals.
	London.	Other ports.	London.	Other ports.	London.	Liverpool.	Other ports.	U. K. ports.		
1880	400	..	..	..	..	..	..	..	400	
1881	17,275	..	..	..	..	..	..	..	17,275	
1882	57,256	8,839	..	..	..	..	..	..	66,095	
1883	63,733	120,893	..	..	17,165	..	..	..	201,791	
1884	111,745	412,849	..	..	108,823	..	..	..	632,917	
1885	95,051	492,269	..	..	190,571	..	..	..	777,891	
1886	66,960	655,888	..	..	331,245	103,454	..	30,000 F	1,187,547	
1887	88,811	766,417	..	..	242,903	398,963	..	45,552 F	1,542,646	
1888	112,214	939,231	..	..	169,282	754,721	..	..	1,975,448	
1889	86,547	1,068,286	..	..	167,936	842,000	..	..	2,164,769	
1890	207,984	1,533,393	..	..	124,413	1,072,118	..	10,168 F	2,948,076	
1891	334,684	1,894,105	1,894,105	..	160,340	950,797	..	18,897 F	3,358,823	
1892	449,488	1,505,377	1,505,377	34,228 L	166,508	1,081,353	..	17,818 F	3,310,022	
1893	636,917	1,821,595	1,821,595	36,083 L	109,808	1,263,915	..	16,425 F	3,884,663	
1894	939,360	1,947,609	1,947,609	10,650 L	171,802	1,199,585	43,428	11,675 F	4,324,109	
1895	969,943	35,560 L M	2,412,331	..	142,038	1,360,968	112,789	19,438 F	5,053,067	
1896	1,565,360	77,883 M	2,211,895	..	245,573	1,392,700	129,933	24,074 P	5,647,418	
1897	1,338,964	68,453 M	2,703,845	..	161,744	1,771,542	161,910	26,275 F	6,232,733	
1898	1,238,653	10,000 M	2,784,101	..	201,895	1,935,365	260,077	..	6,430,091	
1899	1,189,563	15,038 L	3,250,100	..	329,703	1,805,646	349,369	20,000 P	6,869,419	
1900	906,766	37,158 L	3,157,060	..	271,432	1,773,381	288,024	..	6,433,821	
1901	1,194,157	32,401 L	3,234,119	..	342,525	1,952,625	338,955	..	7,094,782	
1902	648,929	75,368 L C	3,668,061	..	411,913	2,081,128	334,455	.. U S	7,219,854	
1903	449,990	28,947 L	4,566,257	17,503 C	650,004	2,141,469	326,964	.. N A	8,180,234	
1904	413,322	37,001 L	3,695,088	190,143 W	746,096	1,831,149	360,456	..	7,273,255	
1905	1,190,584	117,854 L C	3,479,757	224,809 W	1,102,282	1,697,367	403,561	..	8,276,214	
1906	1,339,677	392,651 L &c.	3,818,506	329,782 W	932,986	1,582,606	403,684	..	8,799,892	
1907	1,762,047	575,884 L &c.	4,353,088	444,279 W	1,002,403	1,607,520	405,306	..	10,150,527	
Totals	17,475,480	1,619,448	56,500,458	1,287,397	8,411,390	30,600,372	3,918,911	240,322	120,053,779	

L—Liverpool. M—Manchester. C—Cardiff. I, N—19,560 Liverpool, and 16,000 Manchester. I, C—68,558 Liverpool, and 6,810 Cardiff. P—Patagonia. F—Falkland Islands. U S—United States additional 49,924 (chilled). N A—North America additional 53,577 (chilled). W—West Coast Ports (Liverpool, Cardiff, Bristol, Glasgow, Manchester).

## BOOK THE SECOND.

### ON THE ECONOMY AND MANAGEMENT OF THE DAIRY.

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#### CHAPTER I.

##### OF MILCH KINE.

THE value of the respective breeds of milch kine having been already stated,<sup>1</sup> it will rest with the farmer to make his selection, according to the nature of the soil, and the particular branch of dairying which he means to pursue. If his object is to sell milk, quantity must be the leading consideration; and quality, if he means to produce butter and cheese. Quality must not, however, be wholly sacrificed to quantity, in breeding cows for the milk-trade, for the law demands that milk supplied to the public shall have a minimum standard quality indicated by  $8\frac{1}{2}$  per cent. of solids not fat, and  $2\frac{1}{2}$  per cent. of fat,—together, 11 per cent. of solids. There are no breeds of cows in the British Islands whose milk, under ordinary conditions, will not yield upon analysis more than 11 per cent. of solids, even in early summer, when the grass is young, soft, and very succulent; though perhaps individual cows might be found whose milk would fall below that standard.

It is now admitted that the Channel Islands cattle—the Jerseys and Guernseys—yield richer milk than any other breed of cattle in the country, and this is equivalent to saying that they yield richer milk than any other breed in the world. Probably the little black Kerry cows of Ireland will be found to come next to them in quality of milk, closely followed by the blood-red cows of Devonshire and by the docile and picturesque Red Polls of Norfolk and Suffolk. Of Scottish breeds, the Aberdeen-Angus, the Galloway, and the Highland cows stand before the parti-coloured, hardy, energetic little Ayrshires, but the last-named more than compensate in quantity what their milk lacks in quality. The idea once persistently entertained by many people, that red cattle yielded the richest milk, may now be regarded

<sup>1</sup> See Book i. chap. i.

as archaic and altogether illusory. The breed of a cow, and her own individual qualities, have, along with suitable food, everything to do alike with the quantity and quality of her milk, whereas her colour of hair has little or no bearing upon the question.

There is a considerable difference in the milk-yielding capacity of different cows of any given breed, in respect to quantity and quality, one or both. It usually happens that milk is lowest in quality where it is highest in quantity, and *vice versa*; but no unvarying rule will be found to exist on these points. The "stream of tendency," however, is opposed to any idea which may be held that quantity and quality, in their highest development, are found in partnership, as a rule, in any cow or breed of cows. Nor does it by any means follow that the largest breeds of cattle yield the largest quantity of milk, and certainly it does not seem that they yield the largest total amount of solids. Individual cows of the larger breeds may perhaps be found whose yield of milk, and of total solids in that milk, are greater than those afforded by animals of the smaller breeds; but such cows are somewhat rare, and do not occur so frequently as to stamp the breed to which they belong with a dairy reputation corresponding to the size of the animals. And, indeed, it may be said that the richest milk is not always that which is yielded in small quantities, either by large or small cows, though at the same time it commonly is.

As a matter of fact, there is an almost infinite variability in the flow of milk in different animals of most breeds of cows, and it will probably be found that this variability occurs most generally among the larger breeds, though at the same time the smaller breeds are not by any means exempt from it. In every breed, there may be found tribes and families of cows which are much more famous for milk than is the breed at large; and any family or tribe bearing such a reputation owe it, as a rule, to the careful breeding and training, in that direction, to which they have been subjected. A large flow of milk is seldom maintained for a long period, yet, in reference to this, cows do vary very considerably from each other; for while some cows will hardly milk through half the year, it is with difficulty that others can be let dry for the next time of calving.

It will be seen, therefore, that scope enough exists for the care and energy of any one who, by careful selection and weeding out, has the mind to build up a herd of cows famous for quality and quantity of milk, in which these features shall become hereditary. It is, too, a work of time, of untiring attention, of sound judgment, and it can only be accomplished by a man whose heart is in his business. Breed and breeding are more potent than locality or country, in reference to the evolution of the milk-yielding function; and food and treatment have their influence as well,—an influence not inferior, perhaps, in the long run, to that of natural propensity. In building up a herd of cows great at the milk-pail, it is imperative that only such sires should be used as are known to come from cows and families that are excellent for milk, for the bull indeed is half the herd.

The test as to quantity of milk is easily made by keeping a record of

the weight of milk given by each cow, each time she is milked. Details of the method are given in the description of the milk register on page 245. A spring balance (see fig. 51, p. 246), and a slate at the cow-shed, and Barham's "Sandringham Dairy Record Sheet," will enable anyone to obtain and preserve data which are of the greatest value—nay, indeed, are indispensable—where a herd is being improved for milk. In summer, when cattle roam over the pastures, where the food is the same for all the cows alike, each cow's capacity for milk may be exactly ascertained; and, in winter, the test may be made more searching still by noting the quantity of food consumed, as well as the quantity of milk yielded, by each cow respectively.

The test as to quality of milk, in reference to cream, is not so easy and simple, but it may be taken with a sufficient approach to accuracy by means of a set of graduated glass tubes, called "cream-gauges," which show the cream volume of as many samples of milk as may

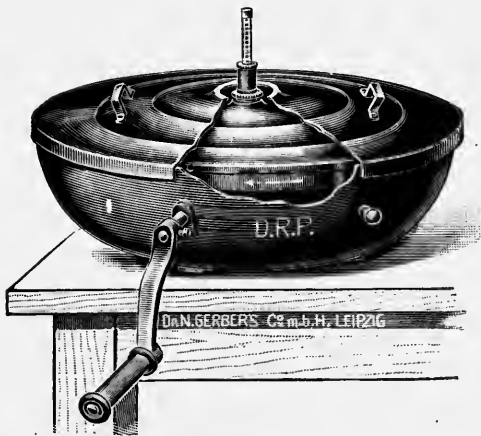


Fig. 50.—Dairy Supply Co.'s Gerber Butyrometer.

be placed within them, in this way instituting a comparison between the milks of different cows. There are also small instruments, adaptations of the well-known cream-separators, in which several samples of milk may be tested for cream, in a few minutes' time. These ingenious machines are rapid in work, accurate in the results they obtain, and very easily turned by hand; they are, consequently, very well adapted to the needs of cheese- and butter-factories, or of any other institutions where it is desirable to test the quality of different milks received.

It may be contended, however, that a cream-test, for volume of cream, is not sufficient to denote the quality of milk, for cream varies in quality. The "Butyrometer" has been designed to ascertain the actual percentage of butter-fat in samples of milk, in order that milk may be bought on a basis of quality at butter-factories and other large

establishments. A number of samples may be tested at once in the machine, an illustration of which is given in fig. 50. The hand crank is gradually brought to a speed of fifty revolutions per minute, and this is maintained for three or four minutes; then the crank is left free, and the disk gradually brought to rest by gentle pressure with a cloth, after which the tests may be read off on the tubes. A hundred samples of milk may be tested in less than an hour, and the result is almost independent of the individual skill of the operator.

Machines of this kind are used, not only by wholesale purchasers of milk for sale as milk, but also generally in creameries, in which milk is purchased from dairy farmers to convert into butter. In Australia and New Zealand the price paid for milk in many creameries is in proportion to the percentage of butter-fat in each lot, and there is no doubt that this is the most equitable method of purchase.

Copious and long-continued lactation, wherever it occurs, is a natural function for the most part artificially developed. It is, in fact, the result of domestication of cattle, in the first place, by breeding and training, but to some extent by soil and climate; for it is found that cattle in a feral state do not yield more milk, or yield it for a longer period, than is necessary to give their offspring a good start in life. The quality of milk is largely a question of feeding, treatment, and climate, yet breed has more to do with it than all of these. We see this demonstrated in the Jerseys and Guernseys more than in any other breed of cattle; the superior quality of their milk is hereditary, and this heredity is no doubt owing to the care and tenderness with which these cattle have been treated for centuries, and to the genial climate of their island homes. The Jerseys, more particularly, exhibit the results of the influences mentioned, as will be seen from the table of figures in the next paragraph; and as these beautiful cattle have been most carefully bred, fed, and tended for a long period, we may accept the results as being conclusive in favour of careful breeding, kind treatment, and a genial climate. Whether or not this quality of milking in the Jerseys will be perpetuated in the breed, in other countries, and through succeeding generations, is a problem which only time can solve, but so far it betrays no sign of falling off in the United States, Canada, and elsewhere. All will depend on breeding and treatment, no doubt, for in any case the quality is now hereditary in the breed, and cannot be sacrificed save by unfavourable conditions.

For some years past, at their annual Dairy Show in London, the British Dairy Farmers' Association have conducted milking trials, and the results have been very instructive. These trials have been made in respect of quality as well as quantity of milk, and the results are summarised by Mr. P. McConnell, in Part I., Vol. VI., of the Journal of the Association, embracing a number of cows of different breeds and extending over a period of ten years. The trials were made by taking for analysis a sample of each cow's milk, at each morning's and evening's milking on one out of two days of the show. From the chemical data thus obtained calculations were made as to



the butter-yielding capacity of each cow, and as to the butter ratio of the milk. The high quality of the milk of certain Jersey cows is remarkable :—One yielded milk containing  $19\frac{1}{4}$  per cent. of total solids, of which  $9\frac{1}{2}$  per cent. was fat ; the butter ratio being 11·4 lb. of milk to 1 lb. of butter. Another yielded milk containing over 17 per cent. of total solids, of which  $8\frac{1}{2}$  per cent. was fat ; here the butter ratio was 11·3 lb. of milk to 1 lb. of butter, or at the rate of over 23 lb. of butter per week. The following tables shew the milking capacity of Shorthorns, Jerseys, and Guernseys,—the only breeds which have been tested by the Association in numbers sufficient to give a reliable picture of their value as milk-producers. But the few Devons, Ayrshires, Red Polls, and Kerries, which have been under test, give very satisfactory and promising results, as also does the single Welsh cow that has been entered :—

Breed.	Lb. of Milk per day.	Percentage of Total Solids.	Percentage of Fats.
119 Shorthorns . . . . .	43·13 . . . . .	12·87 . . . . .	3·73
31 „ „ . . . . .	44·80 . . . . .	12·89 . . . . .	3·81
115 Jerseys . . . . .	27·87 . . . . .	14·36 . . . . .	4·56
43 „ „ . . . . .	28·41 . . . . .	14·94 . . . . .	5·47
49 Guernseys . . . . .	28·30 . . . . .	14·00 . . . . .	4·77
14 „ „ . . . . .	31·15 . . . . .	14·46 . . . . .	5·03

In connection with these figures it must be borne in mind that while the Shorthorns yield more milk, though not necessarily a larger aggregate of solids in the milk, than either of the other two breeds, they are larger cattle, requiring more sustenance, and a greater breadth of land per cow ; they are, however, much more valuable as butchers' beasts when fat, and therefore more profitable when they go barren, or have seen the best of their days as milkers. Eleven Ayrshires, tested at the Dairy Show, yielded an average of 34·26 lb. of milk each per day, containing 13·43 per cent. of total solids, of which 4·15 was fat ; as these are small cattle, hardy, energetic, suitable for inferior land, and for trying climates, it will be seen that they are among the most valuable of our milking breeds.

Fed and treated similarly, it will generally be found that cows yielding the smallest quantity will afford the richest quality of milk ; but this is not by any means an unvarying rule, and we sometimes meet with very striking instances to the contrary. Both quantity and quality frequently vary, in any cow of any breed, or as between any two or more cows of any given breed, of the same age, of similar size and constitution, fed on the same quality and quantity of food, and so on. The state of health of the cow, changes in the weather, in food, in treatment, the period of the year, the time which has elapsed since calving, the degree of succulency and digestibility of the food, the gentleness and attention which are bestowed, &c., &c., have each and all a distinct though perhaps not sufficiently appreciated influence on the flow and quality of the milk. Good old pasture land, not necessarily the richest, but sound land, with a good assortment of indigenous grasses, improved if needful by judicious top-dressing, will as a rule yield the best qualities of both cheese and butter ; but rank pastures,

sewage grass, succulent green crops, and so on, are not well adapted for either purpose. Turnips, mangel, brewers' grains, cabbage, &c., will increase the quantity of milk; but its quality is best improved by leguminous meals, ground oats and maize, which indeed may be fed to milking cows with advantage along with grass through the summer and autumn.

It has been thought that food rich in oil and carbo-hydrates would yield the richest milk; this is not the case, however, for while such carbonaceous food will increase the quantity, albuminoids or nitrogenous food will best improve the quality. The carbonaceous food is well represented in linseed, potatoes, and mangel, which are rich in oil, starch, and sugar respectively; and the nitrogenous food by broken beans and peas, vetches, clover, and their allies.

All the same, however, it is the quantity rather than the quality of milk which the sooner responds to better and increased food, though its quality too will improve when the limit of expansion as to quantity has been reached in this way. Regular feeding on good food will yield more satisfactory results than that which is spasmodic and irregular. The casein in milk varies less than the fats in amount, and while food rich in carbonaceous ingredients is more likely to influence the quantity of butter-fat in milk than nitrogenous food is to alter the proportion of casein, either kind of food will most of all increase the quantity of milk and the proportion of butter in it. Lean cows will yield less and poorer milk than those which, without being actually fat, are kept in good store condition, and the milk of all cows begins to decline in quantity, and to improve in quality, after the first three months of lactation.

Careful investigations into the effect of changes of food on the yield of milk have been repeatedly made, and the following conclusions may be regarded as broadly and fairly established:—Firstly, an increase of food, sustained in both quality and quantity, increases the yield of milk, and also the proportion of solids in it, and the better milker a cow naturally is the greater will be the effect of the foods. Secondly, the proportion of fat in the food bears no special relation to the proportion of fat in the milk, but an increase of fat in the food increases the yield of milk as a whole. Thirdly, while albuminoids from their nature have been supposed to be specially adapted to increase the proportion of casein in the milk, it has been found that a liberal use of them tends more to an increase in the proportion of fat, for casein varies very little as compared with fat in milk. Fourthly, the composition of milk as regards any one of its ingredients does not respond, with anything like fidelity, to changes made in corresponding ingredients in the food the cow eats, and scientific feeding is followed by such uncertain results, save with respect to the increase of the total yield of milk, and, consequently, of the total solids in it, as to preclude the laying down of any definite rule concerning it. The composition of milk, in fact, primarily depends more on the breed, or on the capability, of a cow than on the food she eats; and the limit of milk production is soon reached in a cow not naturally given to much milk, how-

ever rich the food may be, whereas the effect of a plentiful supply of good food on a cow naturally inclined to milk is, as a rule, very considerable.

The need of greater exactitude in the dairy has led to the introduction, within recent years, of the Milk Register. By a milk register is simply meant a record of the quantity of milk yielded by a cow. In other words, it is a quantitative estimation of the milk the cow gives. It affords no information as to the quality of the milk, or as to its butter-yielding or cheese-yielding capacity. Nevertheless, by its means, the milk-producing capacity of a cow can be ascertained exactly, and her character in this respect can be expressed by means of figures about which there can be, or should be, no equivocation. A greater or less degree of exactness can be secured, according to the greater or less frequency with which the register is taken. A register based upon observations made only once or twice a week would be less instructive, and, in a sense, less valuable than a register based upon observations made once or twice a day, though it is by no means implied that even a weekly register would not prove extremely useful.

In the taking of the register two methods suggest themselves, and the question arises, which is the better, that by volume or that by weight? Against the volumetric estimation in, say, gallons, quarts, or pints, there are several objections, amongst which are the trouble of pouring the milk into the measures and the difficulty of allowing for the froth. Chemists, who have brought the art of estimating quantities to great perfection, invariably employ gravimetric methods, even their so-called volumetric processes being based ultimately on proportions by weight. Hence, it seems desirable to estimate the quantity of milk by weight rather than by measure. Moreover, the transition from weight in pounds to the equivalent measure in gallons is easily effected in the case of milk. Thus, the specific gravity of milk being 1.03, it follows that 103 lb. of milk will occupy the same space as 100 lb. of water, but for practical purposes these numbers may be taken as identical. Then, since one gallon of water weighs 10 lb., no appreciable error is involved in considering that one gallon of milk also weighs 10 lb. Consequently, if the quantity of milk given by a cow at one milking be expressed in lb., it is only necessary to place the decimal point on the left of the unit figure to get the equivalent in gallons. Thus 24 lb. of milk represent 2.4 gallons, 15 lb. of milk represent 1.5 or  $1\frac{1}{2}$  gallons, and so on.

The practice of taking the milk register, as followed in a dairy well known to us, may be described. The cows are always milked in the stalls, and during summer they are brought in twice a day for this purpose. After each cow is milked, the pail containing the whole of her milk is hung on a spring balance suspended in a convenient position, and from the gross weight indicated there is deducted the already known weight of the pail. The difference, which represents the weight of milk, is recorded in a book suitably ruled. This book when open presents a view of one week's records. In the left hand column are the names of the cows; on the right of this are fourteen columns,

two of which receive the morning and evening record of each cow. In a final column on the right appears the week's total yield for each cow, and space is also allowed for any remarks. Fractions of a pound are not entered, but 18 lb. 12 oz. would be recorded as 19 lb., whereas 21 lb. 5 oz. would appear as 21 lb., so that a fraction of over half a pound is considered as a whole pound, and a fraction of under half a pound is ignored.

The need of deducting the weight of the vessel is obviated in such a simple appliance as that of the Dairy Supply Company, illustrated herewith (fig. 51). It is easily movable from place to place, and shows

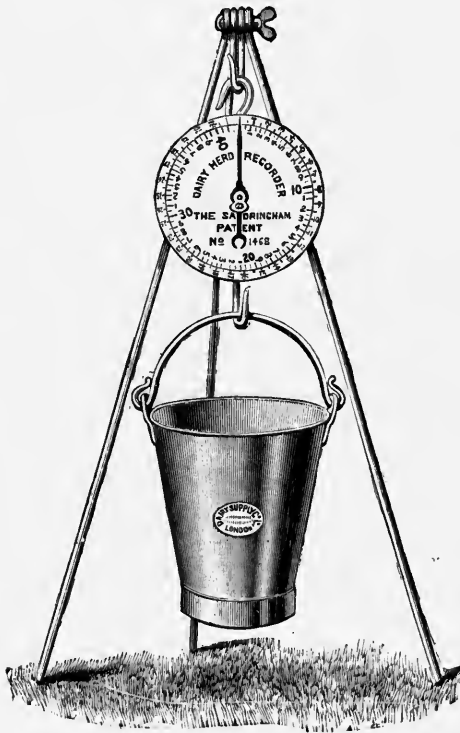


Fig. 51.—Milk weighing Appliance.

on the dial the weight in pounds and ounces, as also the measurement in gallons and pints. As the pail weighs with the machine, no deduction for it is necessary.

Every dairy farmer has some idea, as to each of his cows, whether she is a good, a bad, or an indifferent milker, but such knowledge is at best only vague. By the simple means indicated, the character of each cow as a milk-producer is slowly but surely recorded in a manner which is at once exact and definite.

As such a record affords no information regarding the quality of the

milk, it is obviously of most use to dairy farmers engaged in the urban milk trade. It is, moreover, particularly valuable to the farmer in that it shows to him the relative milk-yielding capacities of his cows, and thus enables him to gradually weed out the naturally poor milkers, and replace them by better ones.

The study of a milk register extending over, say, a year is most instructive. The influence of external conditions on the discharge of the lacteal fluid is clearly indicated. A change in the food supplied to the cows, for example, or the appearance of sharp frosts, as well as other sudden meteorological changes, will be found to be faithfully reflected in the milk-pail. The register may bring out, amongst other circumstances, some such useful fact as the following: that of two cows, for instance, one may be notorious for giving at times large flows of milk never approached by the other cow, and may have acquired the reputation of being the better milker, while the register may prove that, when duration of lactation and average yield of milk are considered, the second cow is decidedly the superior. The register will, in fact, indicate unerringly which are the best milk-yielding cows in the dairy, and which therefore are, with this object in view, the best to breed from. If it is desired to know the richness in cream, then the lactocrite, or some simpler instrument of which there are several kinds, may be called into requisition.

The simplicity and inexpensiveness of the milk register must not be overlooked. These are features which should commend it especially to the notice of small dairy farmers, for with a moderate number of cows it is particularly easy to introduce the register. But even with a large dairy it will be found that, as soon as the system has got fairly established, the additional time and trouble involved will sink into insignificance when compared with the benefits which cannot but accrue from the intelligent study of a faithfully kept register.

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## CHAPTER II.

### OF THE PASTURE AND OTHER FOOD BEST SUITED TO MILCH COWS.

THE feeding of milch kine comprises two distinct methods, viz., *pasturing* and *house-feeding*.

In order to obtain an abundant supply of good milk, where the pasturing of cows is adopted, it is not alone requisite that the grass shall be plentifully produced, but also that it shall be of such quality as will be relished by the cattle; and this property will generally be found in old natural pastures that have been properly managed. Excellent pasturage is, however, provided on the lighter soils, by

new "seeds" which are taken in rotation, and kept down for several years. In the important dairying counties of the south-west of Scotland, large herds of Ayrshire cows are pastured to a great extent on such newly-seeded land, rye-grass being the chief component, and the cheese and butter made from the milk are of excellent quality. New pastures are not always considered to produce the best milk, out on light soils they are commonly superior to old turf; and while in some old pastures there is too generally a large proportion of weeds—including various composite and umbellate plants—which impart a flavour to the milk, the newly-seeded land is usually free from them, because all such plants have been destroyed by cultivation. The newly-seeded land, too, if it has been properly cleaned, is free from the following, which are sometimes found in old pastures:—Hair-grass, Yorkshire fog, quaking-grass, brome-grass, buttercups, plantains, and other plants. These are weeds, cattle do not like them, and they should be eradicated by lime and other top-dressings which sweeten the soil and promote the growth of the better grasses.

Some old pastures, indeed, are so foul with weeds and inferior grasses that to plough them up, take a crop or two of corn, and a summer fallow, or a crop of roots for which the land has been well cultivated, would seem to be the quickest and surest way of exterminating the intruders. On the dry, open soils, this may be done with advantage, perhaps; but on the heavy retentive soils such a course is obviously out of the question on the ground of expense. Top-dressing, indeed, with lime, or with superphosphate of lime and kainit, affords the best solution of the heavy land problem, so far as permanent pasture is concerned. It is likewise worthy of note, that although the long rank grass, growing in orchards or other places, in general feeds well, and produces a flush of milk, yet such milk will neither be so rich, nor carry so much cream in proportion, as the milk of the cows that are fed upon short fine grass; nor will the butter be so good.

The quantity and quality of milk are materially affected by driving cows a long distance from one pasture to another; hence it will be proper to have the steading in as central a part of the farm as possible. It is also of essential importance to have pastures well sheltered and enclosed, as the produce of milch kine will be greatly improved, or deteriorated, according to the attention or disregard bestowed on this point; for, when confined within proper inclosures, they not only feed more leisurely, and are better protected against bad weather, but are also less liable to disturbance than when they wander into other fields. Shelter from the rays of the sun; immunity from being chased about by flies, or dogs, or foolish people; and moderate warmth and quiet are also greatly conducive to an increase of milk.

With regard to the housing of milch kine during summer, a common practice is, where there are proper enclosures, to send them out in the evening, in order that they may lie out during the night, while in the heat of day they are kept more cool and quiet in the cowsheds than in the fields. The advantages resulting from this course are obvious, for the cattle obtain in the night the exercise which is

beneficial, and in the day they are not scorched by the rays of a hot summer's sun, nor are they tormented by the flies, especially the ox warble flies, that are so active in the daylight.

The most general practice in the British Isles, particularly in the Midlands and the North, is to have cows out in the pastures, day and night alike, from May to November. Tethering is not employed very much anywhere, save in the Channel Islands and in a few places in the south of England; it involves a good deal of trouble, for the cows need watching, and moving, and watering, pretty frequently, in addition to milking. The system economises grass, no doubt, but not to so great an extent as in the system called "Soiling,"—that is, cutting all the grass and green crops, and carting them to the sheds, to be consumed there by the cows. There can be no dispute on the point of waste of grass, where cattle roam at large on the land, though the actual waste is less than many men think, except in wet seasons. It becomes, indeed, a question of relative profitableness, as to whether the waste in grazing is equal to the cost of cutting and carting the food to the sheds. This is a problem which every farmer may solve for himself, according to circumstances. But in any case there can be no question that cattle are healthier on the pastures than in the sheds; and as they must be in the sheds during the winter, it is perhaps best, all points considered, that they should be on the pastures when they may, in spring, summer, and autumn.

In boisterous weather, whenever it may occur, cows should be sheltered, or else they will at once fall off in milk. But the shelter need not necessarily take the form of sheds, if only good fences and plantations are available. In winter there is no alternative, and cows must be housed all the time, save in warm and sheltered localities. Exercise, however, even in winter, is always a good thing, if only in walking a short distance to the water, twice a day. Some people advocate open sheds for dairy cattle, attached to warm yards; others loose boxes, one for each cow; and yet others recommend stalls, in which the cows stand side by side, tied by the neck. The latter plan economises litter and room much better, and on the whole is cleaner, than either of the others. Cows in stalls need no litter to lie on, even when the stalls are paved with stone or brick,—if only a layer of clay be put under the fore-feet, to soften the place for her knees, when the cow lies down and rises up. Litter, indeed, in the form of straw, is too valuable, as a rule, in these days, to be used for cattle to lie upon, and it may be declared with authority that they will do very well without it.

Cow-houses are variously arranged. The most convenient are known as double sheds, under which arrangement two rows of cattle stand tail to tail, and each of these rows head to head with another row; where they are tail to tail, a roadway and two manure gutters are between them, and where head to head a gangway or "fodder bing." The dimensions of the stalls may be the following, for large cows: seven feet long, including manger, and six feet six inches wide; this will serve for two cows, with a short partition between them at the manger. The space occupied by the two manure gutters and the path between

them should be seven feet wide. For medium-sized cows, the stalls may be reduced half a foot each way; and for small ones, more in proportion. The "fodder bin" may be any width that is desired—big enough even for a hay barn, if need be; or it and the cow-sheds too may be floored overhead, forming hay-lofts for storing forage. This latter arrangement is, however, now considered more or less objectionable, and other means of storing fodder should, if possible, be provided. In the plan (fig. 52), it will be seen that provision is made for eighteen cows, twelve in a double, and six in a single shed, all under one roof; and it will be obvious that the single shed might be made a double one by simple lengthening of the building. On the whole this arrangement is the best of all, for the doors all open into the yard, and the manure sheds are all out of it, while every convenience for feeding the cattle is provided. It is perhaps as well to say that in order to preserve the volatile and more valuable ingredients of the manure, roofed sheds

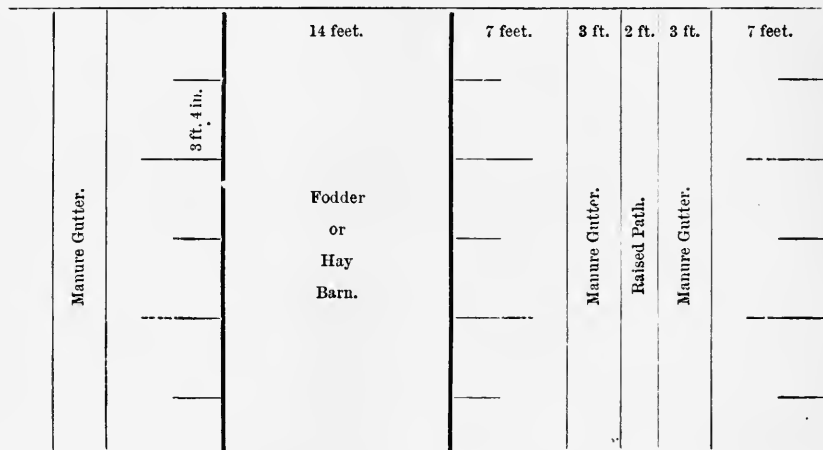


Fig. 52.—Plan of Cow-house.

should be built to contain it until it is taken out on the land. This is the system on which, after long experience and thought, we put up a new set of farm buildings, and managed thereby to secure warmth, light, ventilation, cleanliness, and convenience—the chief desiderata in providing accommodation for cattle.

In the management of milch cows, it is important that they should be kept in good health and in fair store condition all through the year, and particularly in winter—the period when they depend on house-feeding, and have no chance of helping themselves to what they can find. If they fall away in flesh during the winter, from insufficient food, food of inferior quality, exposure to cold and damp, or other causes, they cannot yield as much milk in the ensuing summer as they will if they were in good condition, and it takes them a good part of the summer to "get their backs up again," as the saying goes. Cows should not



be lean when calving-time comes on; for, in case they are, the feeding they may get will have to be very liberal indeed to bring them up to a full yield of milk.

Farmers, as a rule, do not like feeding cows liberally when they are dry for calving, and are therefore yielding no return; yet that is just the time when they can best be got into condition again, ready for another period of lactation. The practice too commonly is to feed them on straw, rough hay, and other inferior stuff that is rightly considered not good enough for them when they are yielding milk; but then, such food is not good enough for them at any time, unless it be improved by the addition of corn, and spice for flavour, or cake. All inferior forage should be improved in some way, and the time to use it up is certainly not when cows are dry for calving, unless it be improved by corn or supplemented by cake; the common practice of keeping dry cows on inferior forage during the period indicated is a mistake, the consequences of which are seen later on, and it seems strange that people can be found who still persist in it. During the winter, therefore, in-calf and in-milk cows should receive food that is nutritious, as easily digestible as possible, sound and good of its kind. Straw alone will not do, and even good hay may with advantage be supplemented by a couple of pounds of cake per day; it is surprising what a difference even this small quantity will make, used week after week and month after month, through the winter, especially when the cows are dry. When cows are fed on straw or coarse hay, alone, without any food more generous in character, the organs of lactation become more or less attenuated and inert, and are not easily or quickly restored to what under generous feeding would be their normal condition. With inferior forage, at least 4 lb. of cake should be given.

It is essential that milch cows should always be kept not only in good store condition, but in a generous state of milkiness, ready and free to work, like a well-oiled machine. A few swede turnips, or some mangel, each day will be found very useful to this end, and two pounds of linseed cake, or boiled linseed on chaff, increased to four pounds when the cow has calved, will keep her in suitable condition, add to the strength of her constitution, stimulate the digestive organs, and enable her to make the best use of the succulent grass of early spring.

In Holland, where the management of cows is carried to the highest perfection, the animals are curried in the same manner, and kept as cleanly, as horses in a stable.<sup>1</sup> If this is an error, it is at least one on the right side, and the invariably high condition of all Dutch dairy stock is the surest proof of their superior management, the chief features of which are,—care in keeping the cattle dry as well as clean, food suitable and adequate to their requirements, and attention to the purity of the water. This last-named point is considered of such importance that the water is not even suffered to be tainted by the breath of the beasts. And yet it is a known fact that cattle frequently prefer the water of ponds impregnated with the urine of other animals;

<sup>1</sup> Baron d'Alton, in "Communication to the Board of Agriculture," vol. i.

a circumstance probably arising from the saline matter which this water contains, and which instinct points out as beneficial to their health.

The extraordinary cleanliness and neatness, which have in the course of centuries become hereditary habits in the Dutch people, are found to prevail everywhere, and in everything, in Holland—in the fields, fences, roads, plantations, houses, buildings, as well as in the management of cattle. On several occasions we have noticed this with much interest, and with regret that such customs do not similarly prevail in other countries. The grooming of milch cows, however, and their better treatment in many ways, is spreading to other lands, and in England, Scotland, Germany, Canada, the United States, and even in Mexico, as we can also testify, dairy cows are treated with great kindness,—well fed, well groomed, well cared-for generally,—in instances numerous enough, perhaps, to act as a leaven that “will leaven the whole lump.” In the south-western counties of Scotland, where the plucky little Ayrshire cows are mostly found, the art of cattle management, and of dairying in all its features, has attained a high degree of excellence; a week or two spent among the dairy farmers in the neighbourhood of the Mull of Galloway, will reveal a condition of things, as indicated, not easily equalled in many other portions of the British Islands.

It has already been intimated that the best summer food for cows is good grass, spontaneously growing on sound land; but when such grass is limited, or failing, then tares, lucerne, and clover, either cut or pastured, may be very advantageously used as supplementary food. There is a prejudice against tares, from their being supposed to render the milk *ropy*; but we have been assured by a farmer who kept twenty-one cows of a mixed breed on the verge of Epping Forest, that he soiled them night and morning on tares during a great part of the summer, without any other assistance than the common pasture of the forest, and that not only was there no appearance of ropiness in the milk, but it was far richer than when the cows were fed on meadow grass, the butter likewise being of the finest quality.

Beans given in conjunction with good pasturage are excellent for keeping cows in milking order, and also in good condition. The beans should be kibbled, and from three to four pounds of the broken material given per day.

Good sweet hay is the staple winter food of a milch cow; the accessories are those usually employed in feeding and fattening cattle. Swede turnips, beans or peas broken, and oil-cake, will render the milk richest. But carrots, mangel, and potatoes may be given.<sup>1</sup> Indeed, on the Continent the mangel is preferred to other roots for feeding cattle,<sup>2</sup>

<sup>1</sup> In the Island of Jersey, about 35 pounds of parsnips are given daily to the cows, with hay. They are found to improve the quality of the cream, which is more abundant than from an equal quantity of milk from cows differently fed—*seven quarts producing as much as seventeen ounces of butter*—and the flavour of the latter is superior.—“Quayle’s General View of the Norman Isles.”

<sup>2</sup> Mr. Harley, at his dairy at Willowbank, put the comparative value of mangel and Swedish turnips to the test. He took an equivalent weight of each, and gave them to

and many accounts are given of the nutritive powers of the potato ; one bushel, *per diem*, with good meadow hay, is said to cause a milch cow to yield as much milk as she would when fed on the finest pasturage.

Turnips of all kinds are apt to flavour the milk more or less unpleasantly ; this, however, it is said, may be prevented by cutting off the crown of the turnip, and giving only the lower portion to the cows ; by pulping the roots, steaming or cooking them ; and by always giving them to the cows immediately after milking. The flavour of turnips is volatile, and may therefore be got rid of under these precautions. It is claimed that placing a small piece of saltpetre in the milking pail will counteract the odour of turnips.

Cabbages are of great service, but they require to be given with a considerable portion of sweet hay ; and, like turnips, are apt to impart an unpleasant flavour to butter, unless great care is taken to remove all the decayed leaves. Kohl-rabi appears to be less objectionable in this respect. Fog, or rowen grass, is reserved for use in late autumn and winter. To these may be added, as generally useful in winter, pulverised oil-cake, linseed jelly, and grains,<sup>1</sup> all of the latter, as indeed any kind of meal, to be used with chaff which has been covered up, moistened with scalding water, and left for several hours to cook. By a judicious use of these various articles, together with a due mixture of dry food, considerable nutriment will be thrown into the system, the regular secretions will be excited, and the quality of the milk very materially improved.

But in some districts, farmers object to the use of roots or green food for milch cows, alleging that it spoils the milk ; they feed this portion of their stock entirely on the best hay and oil-cake during the winter.

Malt has been highly recommended, the animals fed on it being said to yield better flavoured and richer milk than can be obtained from cows kept on roots or cabbages. The expense, however, will always prevent this article of food being used to any great extent.

Steamed food is generally admitted to produce more and better milk than raw. This can hardly be due to increased digestibility ; but where hay is mouldy, the fungoid growth can only by steaming be rendered harmless ; and, indeed, such hay should always be steamed whenever it may be found necessary to use it at all as food. But with regard to hay and straw generally, steaming is not at all necessary to

two lots of cows of equal numbers, great attention being paid to the quantity and quality of the milk produced, and the improvement in the condition of the cattle. In these respects, however, there was found to be little or no variation. The quantity and quality of the milk and the improvement of the cattle were much the same ; but the Swedish turnips were ultimately preferred on account of the deep soil which the mangel required.—“Harley’s Dairy System,” p. 71.

<sup>1</sup> Mr. Harley thus speaks of *grains*.—“When they were plentiful and cheap—which was generally the case in winter—a large portion of them were given with the more succulent food, but they were apt to make the cattle grain-sick. It has been ascertained that, if cows are kept long upon grains or distillers’ wash, their constitution will soon be destroyed, and cattle thus fed should not be kept longer than eight or ten months. A little boiled linseed was considered to be the best antidote in preventing distillers’ wash from injuring the health of the animals ; and wheat-straw, cut short and mixed with the grains, prevented the cows from being grain-sick.”—“Harley’s Dairy System,” p. 74.

increase the digestibility by softening the fibre; the same end may be attained much more easily and cheaply by simply moistening the forage well with water, and leaving it a day to soften.

In some parts of Flanders, after the corn crops have been reaped, the ground is lightly ploughed and sown with spurrey. The cows are tethered on it in October, and a space allowed to each proportioned to the crop and the size and appetite of the animal. The butter from the milk thus obtained is called *spergule butter*. It is not of equal quality with that produced from the common food.<sup>1</sup>

In the midland and northern counties, milch cows are allowed the best pastures during summer, followed in the autumn by eddish, and various green crops, of which cabbage is regarded as one of the most important; and are housed for the nights when the weather becomes cold or wet, one or both, when they receive the first instalments of winter food, which in former days was hay, or turnips and straw where both were cultivated: but a difference was made between those which were rather fresh of milk, and those which were nearly dry, the former having a larger portion of turnips, with the addition of hay, while the latter were put off with little else than chopped straw until within a few weeks of calving, when hay was allowed. In Essex, the system was nearly the same, except that, the produce of the dairy being chiefly butter, turnips were seldom given. Rowen (or aftermath) hay, as being the softest and greenest, was preferred, and the consumption was calculated at two loads (of eighteen cwt.) in the winter, with two acres of summer pasture, and some straw, while drying off.

In the neighbourhood of London, distillers' grains and wash are extensively given to milch cows, and with advantage as regards the quantity of the milk; these articles do not, however, improve the quality. Grains are very liable to fermentation, and fermenting food is injurious to cows.

The vast extension of the country milk-trade has done away with most of the metropolitan cow-sheds, and has changed the character of dairy farming in districts from which milk is sent to London and other large centres. There can be no doubt that the milk-trade has been on the whole more profitable than cheese- or butter-making since 1878; indeed, it may be regarded as being and having been the mainstay of the dairying industry of England. It has led to a vast consumption of purchased feeding-stuffs, and therefore to more generous and liberal rations for cattle, as well as to more elastic and adaptable systems of cropping arable land. Later on we shall have more to say on the subject of the country milk-trade.

In the course of the preceding statements, the *stall- or house-feeding*, of cows during the winter in Holland has been mentioned; and from the remarks of Baron d'Alton, it appears that this method of feeding is there adopted *throughout the year* with greater profit than can be obtained from pasturing. The Baron, certainly, says that cows must be early trained to the confinement of stall-feeding, otherwise they do

<sup>1</sup> Sir John Sinclair's "Hints on the Agriculture of the Netherlands, &c."

not thrive ; but, as the advantages of soiling and stall-feeding are so great, there can be no difficulty in adopting it, and, where it is intended to keep cattle thus, the calves may be easily reconciled to the confinement from an early age.

Mr. Horsfall's system of dairy management, recorded with such fulness and accuracy of detail in the "Journal of the Royal Agricultural Society of England" (Vol. XVII., p. 260, First Series), has deservedly attracted considerable attention. We give here his own description of it:—

"My dairy is but 6 feet wide by 15 feet long, and 12 feet high ; at one end (to the north) is a trellis window, at the other an inner door, which opens into the kitchen. There is another door near to this, which opens into the churning-room, having also a northern aspect ; both doors are near the south end of the dairy. Along each side and the north end, two shelves of wood are fixed to the wall, the one 15 inches above the other ; 2 feet higher is another shelf, somewhat narrower, but of like length, which is covered with charcoal, the deodorising properties of which are sufficiently established. The lower shelves being 2 feet 3 inches wide, the interval or passage between is only 1 foot 6 inches. On each tier of shelves is a shallow wooden cistern, lined with thin sheet lead, having a rim at the edges, 3 inches high. These cisterns incline downwards, slightly towards the window, and contain water to the depth of three inches. At the end nearest the kitchen, each tier of cisterns is supplied with two taps, one for cold water in summer, the other with hot water for winter use. At the end next the north window is a plug or hollow tube, with holes perforated at such an elevation as to take the water before it flows over the cistern.

"During the summer the door towards the kitchen is closed, and an additional door is fixed against it, with an interval between well packed with straw ; a curtain of stout calico hangs before the trellis window, which is dipped in salt water and kept wet during the whole day, by cold water spurted over it from a gutta-percha tube. On the milk being brought in, it is emptied into bowls. (The bowls are of glazed brown earthenware, standing on a base of 6 or 8 inches, and expanding at the surface to nearly twice that width. Four to five quarts are contained in each bowl, the depth being 4 to 5 inches at the centre.) Some time after these bowls have been placed on the cistern, the cold water taps are turned till the water rises through the perforated tube, and flows through a waste pipe into the sewer. The taps are then closed so as to allow a slight trickling of water, which continues through the day. By this means I reduce the temperature, as compared with that outside the window, by 20°. I am thus enabled to allow the milk to stand till the cream has risen, and keep the skim-milk sweet.

"Having heard complaints during very hot weather of skim-milk, which had left my dairy perfectly sweet, being affected so as to curdle in cooking on being carried into the village, I caused covers of thick calico (the best of our fabrics for retaining moisture) to be made ;

these are dipped in salt water and then drawn over the whole of the tin milk-cans; the contrivance is quite successful, and is in great favour with the consumers. I have not heard a single complaint since I adopted it.

“Finding my butter rather soft in hot weather, I uncovered a draw-well which I had not used since I introduced water-works for the supply of the village and my own premises. On lowering a thermometer down the well to a depth of 28 feet, I found it indicated a temperature of 43°,—that on the surface being 70°. I first let down the butter, which was somewhat improved, but afterwards the cream; for this purpose I procured a movable windlass, with a rope of the required length; the cream jar is placed in a basket 2 feet 4 inches deep, suspended on the rope, and let down the evening previous to churning. It is drawn up early the next morning, and immediately churned; by this means the churning occupies about the same time as in winter, and the butter is of like consistency. The advantage I derive from this is such that, rather than be without it, I should prefer sinking a well for the purpose of reaching a like temperature.

“When the winter approaches, the open trellis window to the north is closed, an additional shutter being fixed outside, and the interval between this and an inner shutter closely packed with straw, to prevent the access of air and cold; the door to the kitchen is, at the same time, unclosed, to admit warmth. Before the milk is brought from the cow-house, the dairymaid washes the bowls well with hot water, the effect of which is to take off the chill, but not to warm them; the milk is brought in as milked, and is passed through a sile into the bowls, which are then placed on the cisterns. A thermometer, with its bulb immersed in the milk, denotes a temperature of about 90°. The hot water is applied immediately, at a temperature of 100°, or upwards, and continues to flow for about five minutes, when the supply is exhausted. The bowls being of thick earthenware—a slow conductor—this does not heighten the temperature of the milk. The cooling, however, is thereby retarded, as I find the milk, after standing four hours, maintains a temperature of 60°. This application of hot water is renewed at each milking to the new milk, but not repeated to the same after it has cooled.”

At the Aylesbury Dairy Company's Farms, at Stammerham, Horsa-ham, Sussex, the staple of the food given to cows in the milking-houses is ground oats, which produce very sweet milk. From 5 lb. to 6 lb. of crushed oats, with 1 lb. of other meal—wheat, pea, barley, or maize, according to season and convenience—are given to each cow per day. The meal is mixed with chaff, and with pulped or sliced mangel or cabbage, or with silage, according to season. Over this mixture, a kind of soup, made by boiling linseed, at the rate of 1 lb. per cow in winter, and half that quantity in summer, is poured, and the whole is allowed to heat slightly, the mixture being prepared a day before it is used. Salt, at the rate of 2 oz. per cow per diem, is sprinkled over the food. When silage is used, the quantity given is from 5 lb. to 8 lb. per cow each day. There is an ample supply of

water, which is never allowed to stagnate in the troughs. Indeed, as food and water are given in the same troughs, there cannot be either refuse food or stagnant water, as the unconsumed food must be taken away before the water is turned on, and the latter, of course, must be allowed to run off before the food is put in.

A system of preserving grass and other green food in a succulent condition—ancient in Eastern Europe,—has within recent years been introduced into England. In Hungary the practice of storing forage, and even grain, in pits dug in the earth, has been followed from pre-historic times. Pliny says it was adopted in Greece and Spain, and even in Africa. In the "Journal of the Highland Society" in 1843, Professor Johnson gave a description of the German system of making "sour hay;" and in the "Journal of the Royal Agricultural Society of England," for 1874, it is described as seen in the East of Europe, where the green grass or green maize was crammed tightly down into long trenches four feet wide by six or eight feet deep, and covered over with a foot of earth. During some years little or no notice was taken of the subject in this country, and it was left for the wet season of 1879, in which hay-making was almost an impossibility, to cause English farmers to grasp at any alternative that was within their reach.

In the United States, claims of an extravagant character were made on behalf of ensilage, but as the result of trials made at the Missouri Experiment Station it was concluded that the air-drying method, with dry storage in a good barn in a compact form, is more economical than storing in the silo. Missouri farmers are not advised to build silos until there is a radical change in conditions.

The system, in point of fact, is an alternative to hay-making, and, notwithstanding the circumstance that silage is in a more easily digestible condition than hay, it is probable there are few farmers, to whom farming is something more than a hobby, who will persevere with making of silage if only they can make good hay. In giving evidence on the subject, Sir John Lawes said "his past experience had caused him to form the opinion that a ripe crop of oats, being cut up, straw and corn mixed, produced more meat than the silage. The chief value of silage consisted in its storing, thus producing food available at all times.

"Silage-fed milk was richer to look at and taste, but still they could not trace that the animal fed on silage had made so much butter as that fed on mangel. It was desirable in making silage to avoid chemical change in the silos as much as possible, because fermentation meant loss. In some of his oat silage, as far as they had cut it, the analysis showed a loss of nearly 30 per cent.

"Asked whether, after his experience, he would now go to the expense of building a silo if he had not got one, witness said he was rather doubtful about it. It was very useful, no doubt, but he was not quite sure that he would go to the expense. He could not do without roots. He had not grown buckwheat, and he had no opinion of it as a cleaning crop. Winter oats cleaned land better than any corn crops that he knew of. He had not been able to grow maize; but for

ensilage a maize crop was everything, because it cleaned the land at the same moment. He preferred clover silage infinitely to the oat silage. Sweet silage seems suddenly to go bad frequently; but he had never made any."

One of the most careful farmers of our acquaintance has dropped the system after several years' trial of it, and after forming a favourable opinion of grass silage as a supplementary food for milk cows. Silage, indeed, even when successfully made, can only be used as a subsidiary food for stock, in the place of roots to some extent. Hay, and swedes, or mangel, will be found preferable to hay and silage. To say that silage is better, more nutritive, than the grass from which it is made, is hardly compatible with common sense. In the silo there is fermentation,—sometimes a good deal of it,—and where fermentation occurs there is a loss of nutritive matter. Probably the succulency of silage, as compared with hay, is its chief merit, and it is no doubt useful where no roots are grown. Too much of it will injure the milk, and it may be expected that cows fed extensively on it for two or three years, will, as when fed continuously on brewers' grains, hardly be improved in constitution. It is the writer's opinion that if farmers can make good hay, and will moisten some of it—not soak it—for a few hours, before feeding it to the cows, they will feel no need of silage. All depends, in fact, on whether good hay can be made, and it must be borne in mind that ensilage is not always a success. The subject of ensilage is discussed more at length on page 842.

It is maintained by the best breeders that the mixture of salt with the food is beneficial to the health of stock. Some, indeed, have a lump of rock-salt placed in the manger, at which the cattle may lick when they feel inclined. This is a practice which we strongly recommend.

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## CHAPTER III.

### OF THE SITUATION AND BUILDINGS PROPER FOR A DAIRY—DAIRY UTENSILS.

**A** DAIRY-HOUSE ought, if possible, to be so arranged that its lattices may never front the south-east, south, south-west, or west. A northern aspect is the best, and there should be openings at each end of the building, in order to admit a free current of air. These lattices, which are in every respect superior to glazed lights, may be covered in summer with gauze wire, perforated sheet-zinc, or oiled paper pasted on pack-thread stretched for that purpose, so as to admit the light, whenever it may be necessary to exclude cold winds. A perfect milk-room is one that is dry, clean, cool, well-ventilated, free from atmospheric impurities, and uniform in temperature.



The *situation*, for the sake of convenience, should be near the cow-house as well as the farm-house; but care should at the same time be taken that it is not exposed to the effluvia of the cow-house, stables, or farm-yard, as any bad odour might taint the milk, and give an unpleasant flavour to the butter.

If it can be so managed, the dairy should be well sheltered by trees or by the situation of the ground, on the north, the south, and the east. The grand principle of its construction should be to preserve, as much as possible, an equal temperature both in summer and in winter. This is managed in Switzerland and in some parts of France by the dairy being constructed in the heart of a rock. In Ireland and elsewhere the same result is attained by having double walls and a double roof, with a free circulation of air. The second, or upper roof, may be of roof-felting on a light frame of wood; the object is to secure an "air-cushion," as a non-conductor of heat. In Switzerland the business of the dairy is removed as far up the mountain as convenience will permit, and sometimes, at a considerable distance from the cow-house and the residence of the farmer. A pump, or other source of pure water, should open into the dairy. In a level country, however, like those districts of England in which our largest dairies are found, it will, as above stated, be for the convenience of the farmer to have the dairy as near to the cow-house and his own residence as possible, but while there may be proximity, there should be no direct communication between the cow-house and the dairy.

Where the produce of the dairy is the principal object in view, a little extra expense in the construction of the dairy-house will be ultimately more than repaid by the superior quality of the butter and cheese. The walls of the dairy-house should be double, with an air-space, so as to preserve, as much as possible, the proper temperature, varying from 50° to 55° F. We would recommend hollow bricks for the walls of dairies. These are less liable to damp, from not being absorbent,—the air enclosed within them gives them this peculiarity,—and they retain a more equal temperature within the walls by impeding the transmission of heat.

In winter, it is equally important that the requisite temperature should be constantly maintained. If the building forms part of the house, it will generally be found sufficiently warm without the addition of artificial heat; but in very cold weather, and in detached dairies, unless they are constructed as already described, it will be difficult to preserve the proper temperature without the aid of a stove. In large dairies the expense would be of no consideration, when put in comparison with the advantage; but great attention is required in the control of temperature, for if too much warmth is generated, it will be as injurious as too little, and it will be altogether useless if neglected during the night, for if the dairy is once allowed to become too cold the injury done to the milk cannot be repaired by afterwards warming it. Probably the best way of warming a milk-room in winter is by a well arranged set of hot-water pipes, along the walls and near the floor.

As the greatest cleanliness is requisite in the various departments of

the dairy, a well-arranged building should have separate divisions in order that its business may be properly performed. A *butter dairy* should comprise two distinct compartments, one for receiving the milk, another for performing the operation of churning, and, in addition thereto, a shed for washing utensils, and for the boiler. For a *cheese dairy*, three rooms will be requisite, viz., a milk-room, as before, for making the cheese, a second for salting and pressing it, and a third (which may be commodiously placed as a loft over the others) for storing and preserving the cheese until brought to market. An open shed formed by the projecting roof of the building will generally be found sufficient to scour and dry the vessels in. The dairy should be provided with a boiler, of dimensions suitable to the number of cows kept; and there should also be sufficient space for the convenient performance of all the operations of the dairy, whether it is devoted to the manufacture of butter or cheese.

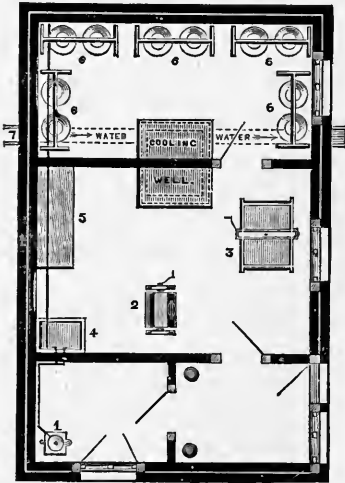


Fig. 53.—Butter Dairy—Ground Plan.

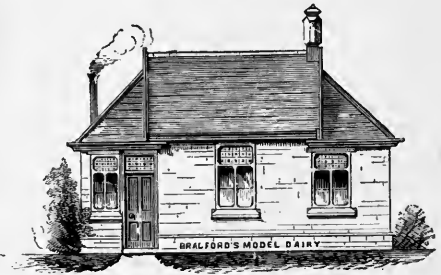


Fig. 54.—Model Dairy.

In fig. 53 we give the plan of a dairy, consisting of a milk-room, churning-room, and a third room divided off into boiler-room, and room for utensils. In the first are seen the milk-stands marked 6, and a fresh-air inlet at 7. In the middle room are respectively seen (2) the churn, (3) the butter-worker, (4) the washing-trough, and (5) the table. In the remaining room is indicated the position of (1) the boiler and hot water cistern. In fig. 54 we give an elevation of this dairy.

During recent years efforts have been made to produce an efficient machine for milking cows, but so far without the measure of success that would be widely welcomed. Cows are being milked by machinery, but not extensively. We may hope that success will yet reward the men who persevere.

The most important and wonderful appliance ever invented for use

in a butter-dairy is the Centrifugal Cream Separator, which has been developed in an extraordinary manner since 1877, in which year we saw the germ or initial idea, in its embryo state, at the Hamburg International Dairy Show. The machine is pretty near perfection, and there are many sorts and sizes of it. It will get more cream out of the milk than can be got by any other means, and it is simple enough to be placed in the hands of anyone possessing the rudiments of mechanical knowledge.

In fig. 55 is seen the Dairy Supply Company's steam- or oil-power

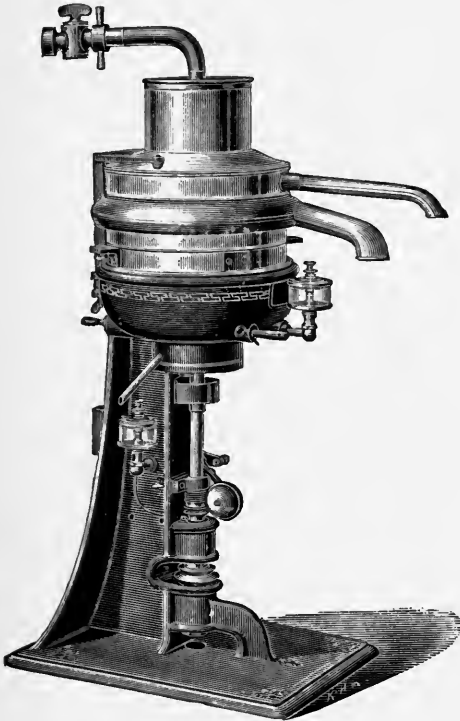


Fig. 55.—Steam- or Oil-power Laval Separator.



Fig. 55a.—Hand-power Laval Separator.

Laval Separator, the capacity of which is to separate the cream from 135 gallons of milk per hour, and fig. 55a shows one of their hand-power separators. The "Baby" is a smaller machine, and there are power machines varying in capacity up to 440 gallons per hour.

The well-known "Alexandra" separator, of which a sectional illustration was given in our fourteenth edition, has been displaced by a neat and compact machine named the "Lister," manufactured by Messrs. Lister & Co. of Dursley. Old types give place to new ones amongst separators, as amongst most other mundane productions, and this may

be accounted as evidence of improvement—presumably so, at all events. It is true enough in respect to separators. Machines are now on the market which, by hand-power only, and that not too strenuous, effectively separate upwards of 100 gallons an hour, whilst power machines are efficient up to and above 400 gallons an hour. Fig. 56 shows a machine of the capacity of 50 to 100 gallons per hour.

The sterilization of milk has become quite a considerable branch of the dairy industry. Fig. 57 depicts the Simplex Sterilizer, introduced by the Dairy Supply Co. of London. This apparatus is made in various

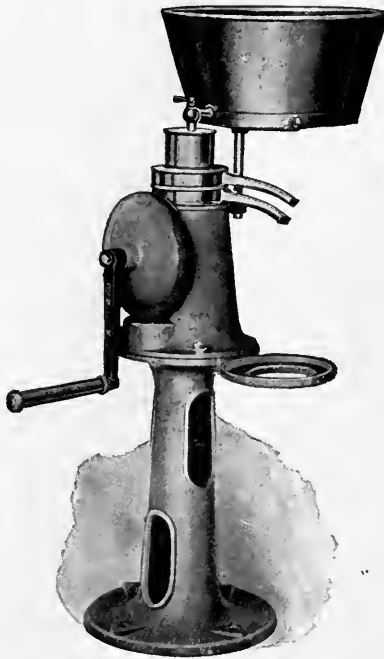


Fig. 56.—The Lister Separator.

sizes, from a capacity of sterilizing 90 to 880 gallons of milk per hour, while a form of different pattern deals with 50 to 1,200 gallons per hour. For the sale of milk in bottles, to be kept for an indefinite period, as on a voyage by sea for example, sterilization, of course, is essential; but a large quantity of milk is also sterilized or “pasteurized” for immediate consumption, as a safeguard against infection from germs of disease possibly contained in it.

Dairy UTENSILS comprise pails, sieves, coolers, churns, creaming-dishes, cheese-vats, ladders, presses, &c.; all of which are so familiar to every dairy-woman, that it would be only waste of time to describe

them. To these should be added a Fahrenheit's thermometer, which should be suspended in a central part of the milk-house. Wood is the material usually employed as a frame in which the thermometer is set, but, even with the greatest care, wooden instruments are apt occasionally to be damp, and to acquire a faint musty smell; the closest attention in scouring and scalding every time they have been used is requisite, as the smallest drop of milk left in them, or the least taint of acidity or mustiness, may spoil the next milk. A metal thermometer-frame will be found more satisfactory, but many disadvantages are avoided by using simply a plain glass thermometer without frame or case.

In some dairies, wooden vessels lined with lead are used. Wherever

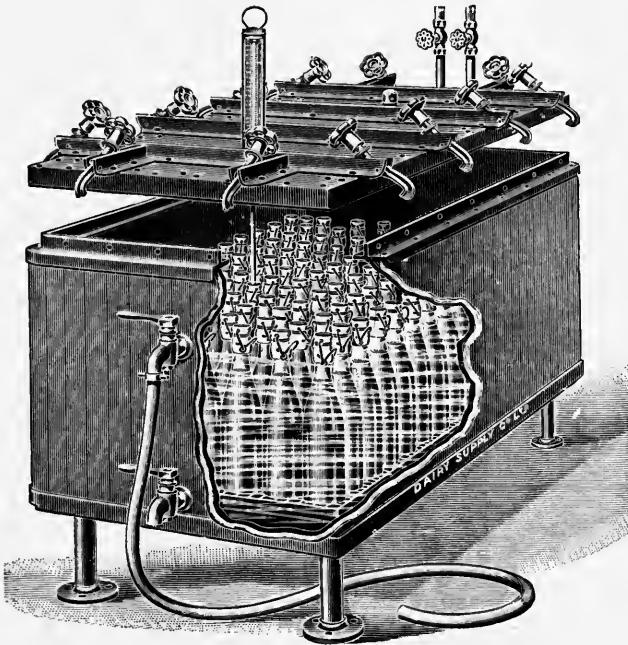


Fig. 57.—The Dairy Supply Co.'s Sterilizing Apparatus.

the size and shape of the utensil will admit, earthenware vessels properly glazed, or glass utensils, will be least troublesome, and glass, being so cheap, now places these latter within the means of most dairy farmers; but lead, copper, or brass utensils, as well as earthenware vessels glazed with lead, although found in many dairies, are to a certain extent objectionable, for the acid contained in milk that has been long exposed to the air forms an injurious compound with these metals, and this, although perhaps not deleterious to any serious

degree, has occasionally been found to impart a disagreeable flavour to the milk. Cast-iron, although it does not form an absolutely poisonous compound with the milk, is by no means unexceptionable, because the result may, in a considerable degree, affect or change the taste and quality of dairy products. This, however, may be perfectly prevented by a due regard to cleanliness. The best milk-pans are of sheet-iron, enamelled inside, and seamless, or else of porcelain. Excellent dairy utensils may now be purchased almost anywhere.

A most convenient and useful milk-stand is seen in fig. 58; this stand may be unhesitatingly recommended as a room-economiser, and,



Fig. 58.—Revolving-disc Milk Stand.

as the discs on which the pans are placed revolve, skimming is greatly facilitated.

The late Dr. Voelcker, in speaking on the shape and size of milk-pans, said that “according to the experience of good dairymen, shallow vessels were the best. They threw up more cream, and preserved the milk better, which were very important considerations. Milk could not be kept together of any depth without its getting heated and spoilt. It was an erroneous view to take, to say that excess of air was injurious to milk. He would recommend that the air should be allowed to penetrate the milk and come in contact with it freely. If, too, they could maintain a current of air through the dairy, it would be all the better; but what would prove very injurious was to have the damp air resting upon the milk. Recently, a little work had been published in Sweden, which recommended that the milk should be exposed in

shallow vessels of a peculiar shape, handy construction, and freely admitting the air. A part of the author's plan was to have a fire in the dairy whenever it was required; and he was informed that when a thunderstorm was seen approaching, instead of keeping the milk cool, a fire was at once lighted, and steam got up, to drive out the additional quantity of moisture. That might be a curious proceeding; but he could readily understand it. It was the damp, moist, heavy air that spoiled the milk. Remove that air by any means, and the milk would keep. It was of the utmost importance to have a dry air in the dairy;

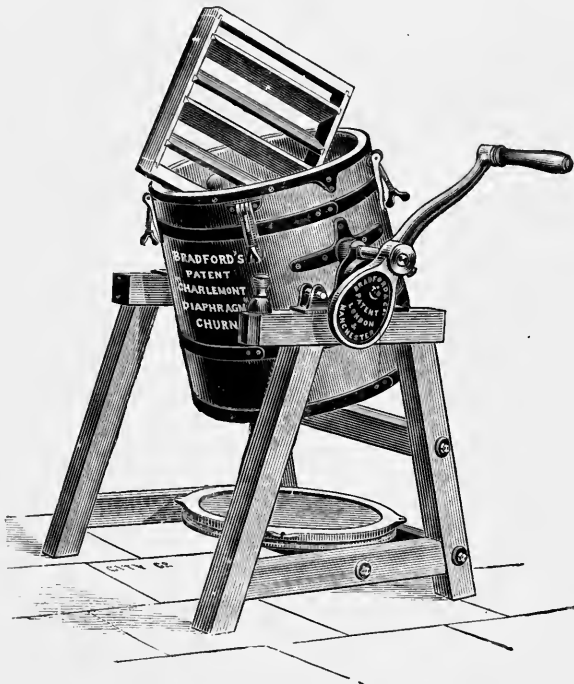


Fig. 59.—“Charlemont Diaphragm” Churn.

and they could now understand why good dairymen always kept the floor as dry as possible. When a thunderstorm approached, the air generally became saturated with moisture, and that moisture had a great deal to do with spoiling the milk. If, however, they drove off the moisture, and with it the excess of water, the milk would keep; so that even in hot weather, when a thunderstorm occurred, an additional fire would preserve the milk good. The fact was a curious and instructive one.”

Slate makes very good milk-coolers, and in some of the midland counties the common flag-slate is employed for this purpose. But, were it not for their fragility, glass and Wedgwood ware would be unrivalled.

Dairy utensils should always be first washed with cold water, then most carefully cleansed with hot water, and afterwards well rinsed with cold water, and kept in an airy place, in order that every possible trace of acidity may be removed.

The number and variety of churns made to-day is almost bewildering, and those by Bradford, Waide, Hathaway, Llewellyn, and other makers, are all excellent in their way, and as nearly as possible perfect. Bradfords' "Charlemont Diaphragm" churn, as seen in fig. 59,—at once simple in construction and easy to clean—is a churn which has, and probably will have, no superior. As will be seen in the illustration, the lid forms one end of the churn, and the large opening greatly

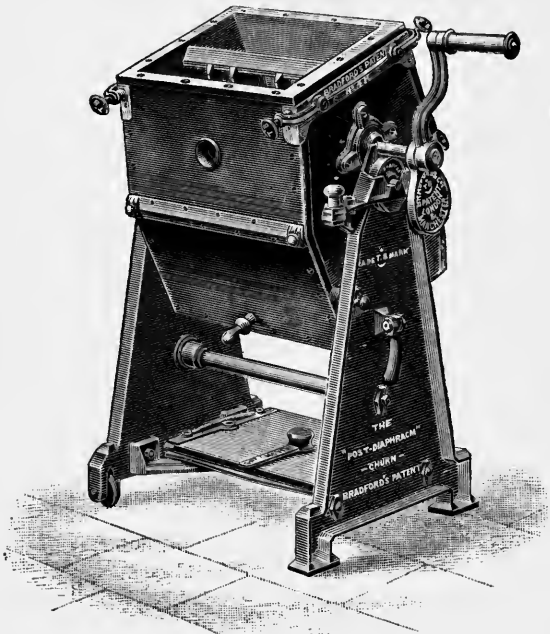


Fig. 60.—"Post Diaphragm" Churn.

facilitates the removal of the butter and the cleaning of the churn. The "diaphragm" beaters are easily removed, so that the churn has all the advantages of an "end-over-end" churn, and those of the time-honoured barrel churn as well.

The "Post Diaphragm" churn (fig. 60) is the latest development of this most effective principle of "diaphragm" beaters in churns, and it is believed that this particular form of churn will give the greatest effect. The churn—whose two sides are each composed of two inclines,—when rotating, carries the cream with accumulative force, in a wave of equal depth (in a round churn the volume of cream is greater in the centre



than elsewhere) against the louvres of the diaphragm. And when it is considered that at the slow and easy speed of forty to forty-five revolutions per minute, the cream passes with this accumulative and increased concussive force eighty to ninety times per minute through the

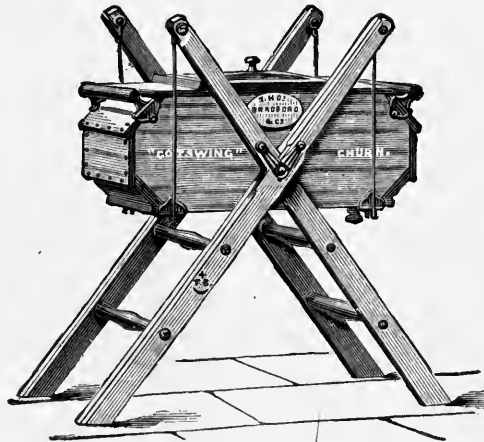


Fig. 61.—“Cotswing” Churn.

louvres, its remarkable churning efficiency will be understood at once by those who have had experience in churning. The lid is seen on the bracing below. To this churn a drainer plug is fitted, and by means of it the butter-milk is drawn out, leaving all the butter in the churn; the plug is seen in the lower half of the churn.

The “Cotswing” churn (fig. 61), is one which simply oscillates,

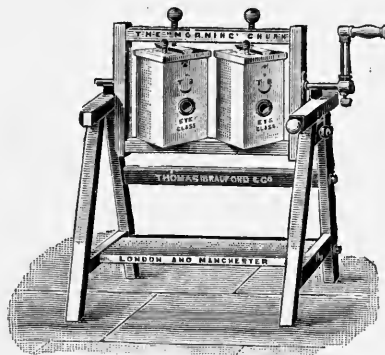


Fig. 62.—The “Morning” Churn.

like a child’s swing-cot, and the cream is churned by being thrown against each end of the churn alternately. It is, of course, extremely simple alike in construction and operation, and also effective; at the same time, save on the ground of fancy, it cannot be recommended in preference to the Diaphragm Churn. The “Morning” churn is a

small churn, for two or three quarts of cream, adapted for persons who keep one or two cows only and want fresh butter frequently, or for those who wish to test the butter-yielding quality of different samples of cream. The illustration (fig. 62) shows a frame containing two separate vessels, and the churn is made with one, two, or three of them in a frame, the single one being also made with a dwarf frame, to stand on a table.

The Triangular Concussion Churns, free from beaters (fig. 63), manufactured by Messrs. W. Waide and Sons, Leeds, make butter on the usual principle of concussion, and, in working, must not be over-

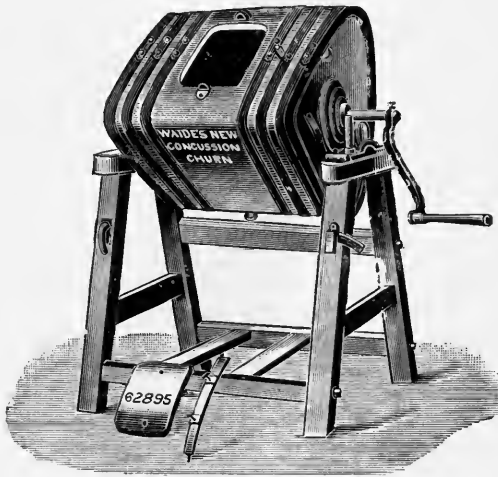


Fig. 63.—Triangular Concussion Churn.

filled. They are made in various sizes to churn from two gallons to forty-five gallons.

At the Plymouth Meeting of the Royal Agricultural Society, in 1890, the Dairy Supply Company, Ltd., exhibited the Instantaneous Butter Maker. The Laval Steam Turbine Separator is employed, and to this the new churn, invented by Dr. De Laval, of Sweden, is attached. It consists of a cylinder about 12 inches long and 4 inches in diameter, within which a dasher revolves at about 3,000 revolutions per minute, being driven by a rope belt, of the same kind as is used to drive a power separator, from the separator spindle. The cream, on leaving the separator in the usual way, passes over an ingeniously contrived refrigerator of new design, which reduces the temperature as low as possible with a very small consumption of cold water; it then enters at one end of the cylinder, in the course of its passage through which the cream is churned into butter, and emerges at the other end in a granular form. Dairymen who have had their butter-milk analysed from time to time, know that there is great loss in the present system of churning large quantities of cream, as it is impossible to ensure that every butter

globule shall receive the same amount of concussion, and hence the butter-milk often contains a large percentage of butter; this is now avoided, as the cream must pass equally through the cylinder, at the same time receiving a regular and rapid concussion from the revolving dasher. The cylinder is enclosed in a water casing, so that the temperature is kept very low, and the butter is consequently firm, whilst there is no possibility of its being overchurned. It is very free from butter-milk, and therefore keeps well.



Fig. 64.—“Arch-Albany” Butter Worker, with Helical Roller.

It might be expected that this practice of churning fresh cream would entail a loss in the quantity of butter, but as a matter of fact it has been ascertained from experiments that this is compensated for by the perfect separation of the butter from the butter-milk. The churn is fixed to the separator frame, and can be attached to any of the Laval machines. As shown on the turbine, the whole process of separating the milk and churning the butter is performed by a jet of steam direct from the boiler, without the intervention of shafting, belting, or an engine of any kind. The churn has no complex arrangements about it, it can be taken to pieces and cleaned with the greatest

ease, and it is an advantage that whilst the separating and churning can be done at one operation, yet they are independent of each other, so that the milk is separated at a warm temperature, ensuring the greatest yield of butter, and the cream is churned at a low temperature, ensuring the finest possible quality. The process is entirely automatic, requiring very little power and attention whilst in use. It is, therefore, a machine for saving labour in the dairy.

The end-over-end churns, free from beaters, and supplied by several



Fig. 65.—“Arch-Albany” Butter Worker, showing the Making-up Board in position, and the Roller when not in use.

firms, are favoured by a great many butter makers. The ancient “Dolly” churn is still in use in some places where butter is churned from milk.

There are various kinds of butter-workers, both for hand use and power, but the most efficient is the kind seen in figs. 64 and 65, this particular specimen being the latest development of the idea, and, as we can speak from experience, a most convenient and effective instrument. The roller, instead of being fluted longitudinally, is grooved helically, like the worm of a screw, the effect of which is that the butter-milk is expressed more certainly, and with less than one-

half the rolling, and the granulation of the butter is preserved. The arched form of the table assists the moisture to flow away from the butter at both ends. The back action of the helical roller brings the butter back into a mass, ready for rolling out again. The "Arch-Albany" butter worker is made by Messrs. T. Bradford & Co., 140, High Holborn.

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## CHAPTER IV.

### THE SECRETION OF MILK.

IN order adequately to understand the organic mechanism whereby milk is produced it is desirable first to inquire what becomes of the food which the cow eats—of the grass she grazes in the pasture, or of the cake, roots, or hay supplied to her in the stalls.

Cattle, sheep, and ruminants generally are popularly described as possessing four stomachs. It is, perhaps, more correct to say that these animals each have one stomach, comprising four compartments. The names of these are many; in the order in which the food traverses them they are:—

1. The rumen or paunch ;
2. The reticulum or honeycomb ;
3. The omasum,<sup>1</sup> psalterium, liber, manyplies, manyplus, or many-leaves.
4. The abomasum, or reed, or rennet stomach.

The capacity of the stomach of the cow is enormous, amounting to from fifty to sixty gallons. It fills the greater part of the abdominal cavity, and the paunch alone occupies nine-tenths of the entire volume of the stomach, the remaining three divisions constituting a mere chain on the front left side of the paunch. In the sheep, though absolutely smaller, the paunch is relatively as large as in the ox. The fourth division, or abomasum, is the part of the cow's stomach the internal lining membrane of which secretes gastric juice. In other words, only the fourth compartment is capable of exercising the digestive function. It is called the rennet stomach, because it is the fourth compartment of the calf's stomach which is salted and preserved in the form of "vells" to furnish natural rennet for use in cheese-making. The secretion of the peptic glands, which line the abomasum, supplies the rennet.

Like all ruminants the cow can stow away in the rumen or paunch, as the first division of the ruminant stomach is called, an enormous

<sup>1</sup> Gr. *omos*, raw.

quantity of vegetable food. This, at a suitable time is regurgitated into the mouth, where it is mixed with abundant juice of the salivary glands and reduced to a fine condition between the teeth. Passing again down the gullet, the masticated food is this time directed into the fourth division of the stomach—the reed or rennet stomach, or abomasum. The glands lining this stomach pour out abundant gastric juice upon the food, which is at the same time kept in continual motion by the peristaltic contractions of the wall of the organ. Through a narrow aperture, the pylorus, the food, which is now called chyme,<sup>1</sup> passes next into the small intestine, a tube from half an inch to three quarters of an inch in diameter, and some fifty yards long. About two feet from its place of origin at the pylorus the small intestine is pierced by the bile-duct, a vessel which pours into the intestine the special secretion it derives from the liver. About fourteen or sixteen inches farther on another tube enters the small intestine, this is the pancreatic duct which conveys from the pancreas or sweetbread a juice which is likewise poured into the intestine. Thus the small intestine receives from outside itself two secreted fluids, the bile and the pancreatic juice, and furthermore the inner lining of the small intestine itself is beset with glands which pour out a juice called the succus entericus. Finally, the small intestine after coiling about in an indescribable manner opens abruptly into the side of the large intestine, a tube of varying diameter, and from thirty to forty feet long, its excretory orifice communicating with the exterior of the body.

Thus, the food taken in at the mouth is passed through the pharynx into the gullet, which leads into the stomach, where the food is reduced to a sort of pea-soup consistency, and is then called the chyme. This escapes through the pylorus into the small intestine, after traversing which the food material enters the large intestine terminating in the excretory orifice whereby the refuse of the food is ejected. During its passage along the alimentary canal the food is attacked by a number of digestive juices, comprising the saliva, the gastric juice, the bile, the pancreatic juice, the succus entericus, and the juice of the large intestine. Each of these juices has its own special and appropriate function, the gastric juice, for example, dissolving the nitrogenous constituents or proteids of the food, the bile assisting in emulsifying the fats, and the general result of their combined action being to separate from such apparently unpromising materials as grass or roots, hay or oil-cake, their nitrogenous or flesh-forming constituents, their carbohydrates or sugar-like ingredients, and their fats or oils. Hence, what is taken in at the mouth as hay or grass becomes, in the small intestine, a grumous mixture of soluble peptones, derived from the nitrogenous food constituents, and of soluble carbohydrates, emulsified fats, and indigestible fibre.

But the digestion of the proximate constituents of the food-stuffs in the intestine would be of little avail, did not the system provide some means whereby the contents of the intestine can be removed from that

<sup>1</sup> Gr. *chuma*, a thing poured.

tube, and transferred to any or every organ of the body where they may be required, no matter for what physiological purpose. Such means are afforded by the blood, and by the blood alone. It is an established fact that most of the absorption of nutrient substances contained in the food takes place from the chyme in the small intestine. To understand how this absorption is effected it is necessary to inquire into the structure of the small intestine and to see what facilities the arrangement of its tissues offers for the accomplishment of this purpose.

Of the several coats or layers which make up the small intestine the innermost one is of chief interest in this connection; it is called the mucous membrane of the intestine and it is beset with numerous small simple glands which secrete the succus entericus, but of which no further mention need be made. This internal lining membrane is also furnished with innumerable small outgrowths which impart to it a somewhat villous or velvety appearance, and each little process is appropriately called a villus. The villi are almost microscopic in size, and they are so abundant and close-set as to confer upon the free surface of the mucous membrane an appearance like that of the pile of velvet. The structure of a villus is somewhat complex; its outer part consists of a coat of delicate thin-walled cells forming what is called an epithelium. Along the middle of the inside space of the villus there extends a more or less branched thin-walled tube, the various parts of which originate blindly within the villus and coalesce into one main tube which passes out of the villus at its base and finds its way into the deeper walls of the intestinal canal. This narrow tube is similar in origin and structure to numerous other tubes which are to be found arising spontaneously in nearly all parts of the body, and are known as lymphatic capillaries, but, for a reason that will be presently mentioned, the lymphatics of the small intestine are distinguished under the name of lacteals. Between the lacteal and the epithelial wall of the villus there is a magnificent network of delicate, narrow, thin-walled blood-vessels (capillaries), and at the base of each villus a minute artery enters and breaks up into the capillaries which subsequently coalesce so that their contents are poured into one or two equally minute veins which leave the villus at its attached or basal end. It is not difficult then to imagine the structure of a villus: the central or axial part is occupied by the lacteal, this is quite surrounded by a network of blood capillaries, which, in its turn is completely enveloped by a sheath of epithelium, enclosing the inner structures like a thimble does the tip of the finger (fig. 66, page 274).

The importance of the villi will be appreciated when it is stated that it is through their agency that the nutrients of the food are abstracted from the chyme of the small intestine. Substances in solution, such as peptones, carbohydrates, and salts, pass readily through the epithelium of the villus and through the delicate walls of the blood capillaries into the blood itself, and so leave the villus by the little veins that pass away at the deeper end. Hence, the blood that leaves the walls of the intestine by the intestinal veins differs in composition from that

which is brought to them in the intestinal arteries; notably it has gained soluble nitrogenous compounds and soluble carbohydrates. All the blood collected from the intestinal walls is poured ultimately into a large vessel called the portal vein, which enters the liver and distributes its contents among the capillaries of that organ, so that the blood from the intestine is submitted to the action of the liver, though what that action is it is not necessary here to inquire. The blood of the liver is in the end

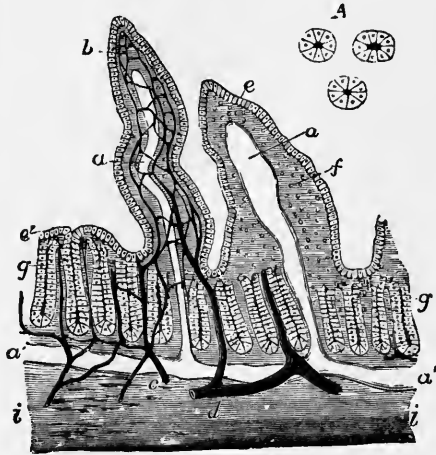


Fig. 66.—Vertical Section of the Mucous Membrane of the Small Intestine (Magnified 150 diameters).

Two villi are represented. In the one on the right hand the dilated lacteal alone is shown, in the other the blood capillaries and lacteal are both seen injected, the lacteal white, the blood-vessels dark; the section is carried through the tubular glands into the sub-mucous tissue; *a*, the lacteal vessels of the villi; *a'*, the horizontal lacteal, which they join; *b*, capillary blood-vessels in one of the villi; *c*, small artery, conveying blood to the capillaries of the villus; *d*, vein, carrying blood away; *e*, the epithelium cells covering the villi; *g*, tubular glands (called crypts of Lieberkühn), which secrete the succus entericus, or intestinal juice; *i*, the sub-mucous layer. *A*, cross-section of three tubular glands more highly magnified.

collected by the hepatic veins, which pour their contents into a great vein called the posterior vena cava, and this passes forward and opens directly into the right side of the heart.

Let us return to the intestine and find out what becomes of the fats of the food. Very minute quantities of fatty matter may find their way into the blood capillaries of the villus, and so pass into the portal vein, but by far the greater quantity of the particles of emulsified fat pass into the villus and enter, not the blood capillaries, but the lacteal. It will presently be useful to inquire exactly how this is effected, but it is more to the point now to see what becomes of the fat after it enters the lacteal. The lymphatics of the small intestine resemble the blood capillaries in that they coalesce into larger tubes or vessels, and it is because, after a meal rich in fatty matters, the lymphatics of the small



intestine are seen to contain a milky-looking fluid termed chyle,<sup>1</sup> that these tubes have received the name of lacteals. It may be well to mention here that this fluid is quite different and distinct from that which is obtained from the mammary gland. The lacteals which contain it find their way to the posterior end of a long irregular tube, which extends beneath the spine, and there discharge their contents. Because the greater part of the length of this tube extends along the dorsal side of the thorax, or chest, it is termed the thoracic duct, and the dilated posterior end which receives the emulsion of fat from the lacteals is appropriately named the receptacle of the chyle. The thoracic duct also receives the fluid collected by most of the lymphatics from all parts of the body, but this is a thin watery fluid consisting chiefly of the oozings through the walls of the blood capillaries. The thoracic duct must, of course, get rid of the materials it is continually receiving, and in the cow it pours its contents, about in the region of the first rib, into a large vein which joins almost immediately the anterior vena cava, another great vein opening into the right side of the heart. Thus it appears that the nutritious ingredients of the food, whether they leave the intestine by the blood capillaries of the villi, or by the lacteal roots of the same structures, find their way into the blood of the right side of the heart.

The tubes or vessels which convey blood to the heart are called veins, those which carry blood from the heart are arteries. The heart is a hollow muscle possessing two main cavities, one on each side, and so arranged that there is no lateral communication in the heart itself between these two chambers. The entire apparatus of the circulation is so constructed that the rhythmical contractions of the heart shall drive the blood in one direction, and in one direction only. When the heart contracts—and its contraction produces the “beat”—the blood is driven into certain arteries which break up into smaller arteries, and finally into exceedingly narrow tubes called capillaries, so that if a fleshy part of the body be cut without injuring any blood vessel discernible by the unaided eye, the blood nevertheless wells forth from the severed capillaries. The capillaries gradually coalesce into small veins, and these into large veins, while the largest veins of all pour their blood into the heart again. The blood on the right side of the heart differs from that on the left side; the former is dark, almost black, while the latter is bright scarlet. The reason for this may be discovered by examining somewhat more carefully the results of the heart's action.

Commencing with the blood in the right side of the heart, the effect of the systole or contraction of the organ is to drive the dark blood out through the pulmonary artery into the lungs, in the capillaries of which the hot dark fluid is exposed to the influence of atmospheric air. The blood receives from the air its oxygen gas, and gives in exchange carbonic acid gas and water vapour, which pass out in the expired air. It is this deprivation of carbonic acid gas and addition of oxygen gas which causes the dark blood to become scarlet. The blood in the capillaries

<sup>1</sup> Gr. *chulos*, juice.

of the lungs is collected by the pulmonary veins and poured by them into the left side of the heart, whence it is, in its oxygenised state, driven out through a strong artery, the aorta, which through its branches supplies the capillaries of all parts of the body except the lungs. One of its branches, for example, supplies the kidney, where the nitrogenous waste of the blood is separated in the urine, another supplies the mammary gland in the cells of which the milk is elaborated from the blood, various other ones break up into the innumerable capillaries beneath the skin which permit of their blood giving up a considerable quantity of moisture in the form of perspiration. But sooner or later all the capillaries of the body in general pour their blood into small veins, and these into larger veins, till finally all the blood so collected is poured into one or other of the great veins, the posterior vena cava and the anterior vena cava, which have already been spoken of, and from them the blood passes again into the right side of the heart.

The walls of the blood capillaries are so thin as to allow of their being permeated. Hence, it is in the vicinity of the capillaries that the nutritive work of the blood is performed, and new tissue is built up, and it is also by means of the capillaries that the waste materials that accumulate in the tissues of the body find a road into the blood and are carried away; were they allowed to accumulate in the tissues disease would speedily ensue. It is in these capillaries of the system in general that the blood, in consequence of the duties it discharges, becomes more laden with carbonic acid and changes colour from scarlet to black. Moreover, in the irrigation of the tissues, which is a necessary consequence of the oozing of the blood through the capillary walls for the performance of its nutritive work, some means are requisite to convey away the fluid which would otherwise accumulate, and these means are afforded by the minute tubes called the lymphatic capillaries which convey their watery contents, the lymph,<sup>1</sup> mostly into the thoracic duct, so that in the end the overflow from the blood capillaries finds its way again into the blood—into that, in fact, which enters the right side of the heart.

As the mammary gland can only elaborate milk out of the materials brought to it by the blood, it may be as well to mention the route which the blood takes in travelling from the heart to the udder. The arterial blood is pumped from the left side of the heart into the aorta, passing along which, the blood reaches the external iliac artery, and this is continued on into the femoral artery, extending more or less parallel to the femur, or thigh-bone. The femoral gives off a branch, the pre-pubic, which in turn gives off a branch, the external pudic, and this, after passing through the inguinal ring, divides into two branches, the anterior, or subcutaneous abdominal artery, and the posterior abdominal, or mammary artery, and it is from these that the blood supply of the capillaries of the mammary gland is immediately derived; of the two the mammary artery is the more voluminous.

The blood after passing through the capillaries of the mammary

Lat. *lymphæ*, water.

gland is collected into the abdominal subcutaneous vein, commonly known as the "milk vein." In cows this vessel is particularly large; it extends along the under surface of the abdomen to near the end of the sternum, or breast-bone, where it turns inwards to join the internal thoracic, or internal mammary vein, the openings in the abdominal wall through which these vessels pass being known as the milk fountains or doors. The internal mammary conveys its blood to the vein of the arm, and this joins the anterior vena cava which empties into the right side of the heart. By this route, then, the blood which has been submitted to the action of the mammary gland is returned to the heart.

Although the nutrients of the food stuffs have been shown to enter the blood, it is not implied that they there preserve their individuality. Indeed, it is easy to show that the contrary is the case. Blood consists of a liquid plasma in which are suspended enormous numbers of microscopic solid bodies called corpuscles, and the red colour of the great majority of these imparts the characteristic tint to blood. Physically, milk resembles blood, in that it also consists of a watery fluid in which are suspended immense numbers of minute solid bodies, the fat globules, which, being white, make the whole milk appear to be this colour; the different colour of skim-milk is partly due to the fact that most of the white fat globules have been removed. Blood is slightly heavier than milk, the specific gravity of the former being 1.055 and of the latter 1.03. Blood placed in contact with non-living matter speedily coagulates, milk in similar circumstances does not. The coagulation of the blood is due to the separation of a material called fibrin from the plasma, and the entanglement of the corpuscles in the meshes of the fibrin. Thus is formed the clot, and the clear pale liquid which remains after separation of the fibrin from the plasma is called the serum.<sup>1</sup> Hence the blood consists of serum, fibrin, and corpuscles, though the fibrin does not exist as such in the living blood. In round numbers, the percentage composition of the serum is, of water 90; of nitrogenous substances, 8 to 9; of fat, extractive, and saline matters, 2 to 1. Of the corpuscles there are two kinds, the red and the colourless, but the former are nearly a thousand times as numerous as the latter, and contain 56.5 per cent. of water, and 43.5 per cent. of solids, the latter being almost entirely nitrogenous organic matter. The fibrin which separates from the plasma is also made up of nitrogenous organic matter. When the corpuscles on the one hand and the serum on the other are dried and ignited, and their ashes analysed, the leading mineral constituents of the corpuscles are found to be the chloride and phosphate of potassium, and of the plasma soda and chloride of sodium. "The corpuscles differ chemically from the plasma, in containing a large proportion of the fats and phosphates, all the iron, and almost all the potash, of the blood; while the plasma, on the other hand, contains by far the greater part of the chlorine and of the soda."<sup>2</sup> The extractives of the blood, though not abundant in quantity, are numerous and variable, the chief ones being urea, kreatin, sugar and lactic acid. These few details may serve to show what a very complex

<sup>1</sup> Lat. *serum*, the watery part; in particular, the watery part of curdled milk, whey.

<sup>2</sup> Huxley, "Physiology," p. 72.

substance the blood is, and what is the nature of the materials from which the mammary gland has to elaborate the milk.

The average percentage composition of the whole milk of the cow is contrasted with that of skim-milk in the following table:—

	Whole Milk.	Skim-Milk.
Water . . . . .	87·0	90·0
Albuminoids . . . . .	4·0	3·7
Milk-Sugar . . . . .	4·6	4·8
Fat . . . . .	3·7	0·8
Ash . . . . .	0·7	0·7
	100·0	100·0

The albuminoids, or nitrogenous compounds, are casein and albumin, the latter in ordinary cow's milk constituting not more than one-ninth of the total albuminoids; the ash consists of lime, potash, soda, magnesia, and iron, with phosphoric acid and chlorine. As may be inferred from a comparison of the foregoing tables, most of the fat is removed in the cream; theoretically all the fat should be removable in this way, and in the most efficient centrifugal separator the residue of fat which is left in the skim-milk is as little as 0·2 per cent. It is further evident that the liquid part of the milk, after separation of the fat globules, still retains all the milk-sugar and most of the albuminoids. It is worthy of note, too, that skim-milk contains the same percentage of water as the serum of blood.

The subjoined tables, quoted after Duclaux, throw additional light on the subject of the composition of cow's milk:—

COMPOSITION OF COW'S MILK AND OF SKIM-MILK.

	Whole Milk.	After Setting.		After Centrifugal Separator.	
		Skim-Milk.	Cream.	Skim-Milk.	Cream.
Water . . . . .	87·25	89·70	58·63	90·73	29·54
Fat . . . . .	3·50	0·77	35·00	0·46	66·67
Casein and albumin . . . . .	3·90	4·02	2·75	3·31	1·22
Milk-sugar . . . . .	4·60	4·74	3·12	4·73	2·17
Ash . . . . .	0·75	0·77	0·50	0·77	0·40
	100·00	100·00	100·00	100·00	100·00

PERCENTAGES OF DRY MATTER IN THE MILK OF THE SAME COW AT DIFFERENT DATES.

	August 11.		August 24.		September 28.	
	In Suspension.	In Solution.	In Suspension.	In Solution.	In Suspension.	In Solution.
Fat . . . . .	3·22	...	2·75	...	2·34	...
Milk-sugar . . . . .	...	4·98	...	5·38	...	5·07
Casein <sup>1</sup> . . . . .	3·31	0·84	2·72	0·55	3·22	0·68
Phosphate of lime . . . . .	0·22	0·14	0·21	0·14	0·18	0·22
Soluble salts . . . . .	...	0·39	...	0·35	...	0·38
	6·75	6·35	5·68	6·42	5·74	6·35
Total dry matter . . . . .	13·10		12·10		12·09	

<sup>1</sup> The casein "in solution" represents albumin.

COMPOSITION OF THE ASH OF COW'S MILK.

Chloride of sodium . . . . .	16.23
Chloride of potassium . . . . .	9.49
Potash . . . . .	23.77
Lime . . . . .	17.31
Magnesia . . . . .	1.90
Oxide of iron . . . . .	0.33
Phosphoric acid . . . . .	29.13
Sulphuric acid . . . . .	1.15
Silica . . . . .	0.09
	99.40

In what way do the tissues of the mammary gland prepare milk from the blood which comes from the heart? Milk, like bile, gastric juice, pancreatic juice, saliva, and urine, is a secretion, and it is formed through the activity of certain living cells which constitute the internal

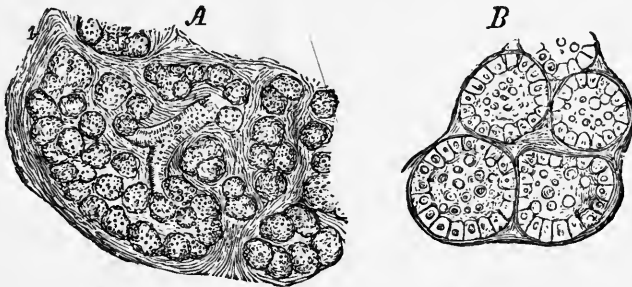


Fig. 67.—Magnified Sectional Views of the Mammary Gland during the Period of Lactation.

A, Section of a small lobule of the gland, magnified 60 diameters; 1, ground-work of connective tissue supporting the glandular tissue; 2, terminal branchlet or one of the excretory tubes; 3, alveoli.

B, Four alveoli, magnified 200 diameters, showing the lining epithelial cells and some milk globules.

lining of the ultimate branches or sacs of the mammary gland. Each terminal branch, in fact, is formed by the confluence of several blind, saccular or flask-shaped, wavy tubes, called alveoli<sup>1</sup> (fig. 67).

The cow's udder, or milk-bag, is provided with four delivery tubes or teats, each of which (fig. 68), with its gland, is termed a "quarter." When a cow is said to have "lost a quarter," it means that one of the teats has ceased to yield milk. Besides the external covering which binds together the whole of the udder, each gland has its own special fibrous envelope, and is distinct from, and independent of, the other glands; hence, though the function of one gland, or "quarter" may be impaired, the others may continue to act in the usual way. The orifice at the free end of the teat is a narrow tube, which is ordinarily closed. In the body of the teat this tube is much wider, but becomes constricted again at the region where the teat merges into the udder. Above the constriction is a large space, "the milk cistern," or

<sup>1</sup> Lat. *alveolus*, a little hollow.

reservoir, which becomes distended with milk as the secretion accumulates. Into each of the four milk cisterns innumerable tubes open. Any one of these may be traced back into minute tubes or ducts, which end blindly in several small sacs or bags, and it is these latter

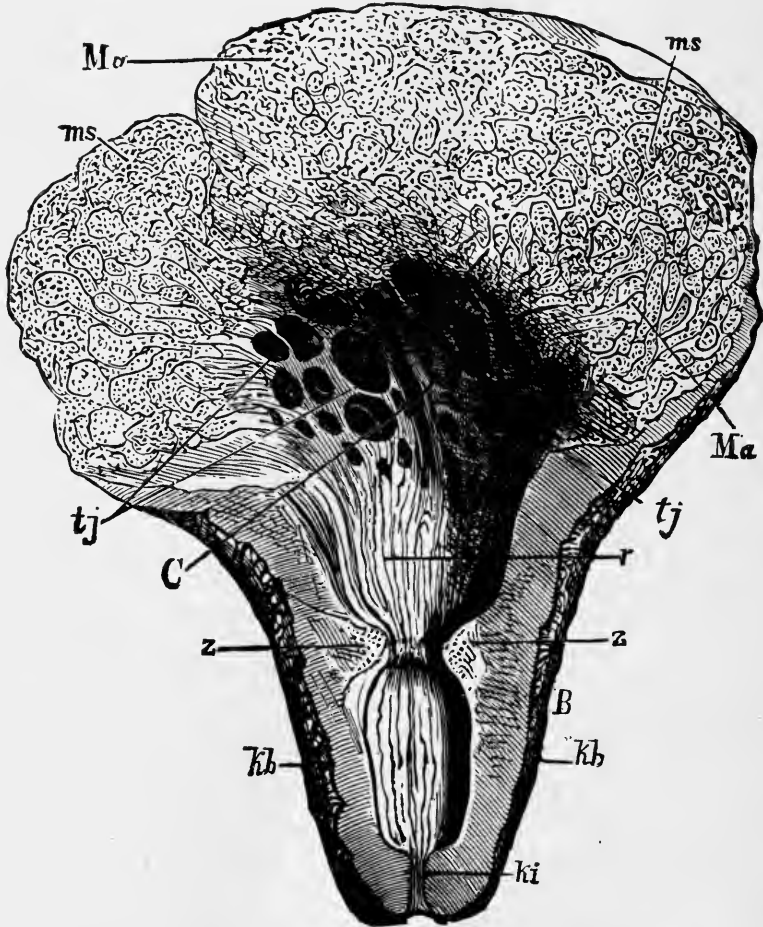


Fig. 68.<sup>1</sup>—Section of Udder and Teat of Cow (*Thanhoffer*).

Ma, gland substance; B, nipple or teat; ms, acini of gland; tj, milk ducts; C, milk-cistern; r, folds in wide milk-ducts; z, section of sphincter muscle; kb, external skin; ki, narrow milk-duct in the nipple.

which are called alveoli. The delicate walls of the ducts and the alveoli are lined by a single layer of minute living cells, which are the secreting cells of the mammary gland. The whole gland is richly supplied with blood by means of thin-walled blood capillaries, a dense

<sup>1</sup> Figs. 68, 69, and 70 are reproduced by permission from Dr. Meade Smith's "Physiology of the Domestic Animals." London and Philadelphia: F. A. Davis.

network of which surrounds every alveolus. Out of the blood thus placed at their disposal the secreting cells manufacture milk, which flows along the ducts, and accumulates in the milk cistern at the top of each teat. The general plan, here described, upon which the mammary glands are constructed, is similar to that of the salivary glands of the mouth.

In the active gland each alveolus encloses a relatively large cavity, varying in size in different alveoli; it is lined internally by a single layer of columnar epithelium cells, each containing protoplasm and a nucleus. The transparent homogeneous granular-looking substance called *protoplasm* is living matter, by and from which all the tissues of animals, and of plants, are built up; its composition is ever changing, it is throughout active life continually receiving new matter, and is constantly parting with material which has been elaborated within itself, hence it is impossible to assign to it any definite chemical constitution. "For the living and life-giving protoplasm is endowed with internal forces, and as the result of this, with an internal and external variability which is wanting in every other known structure; its active molecular forces cannot, in short, be compared with those of any other substance. The capacity which protoplasm has, in consequence of the forces which become manifested in it, of assuming definite external forms, and of varying these, as well as its capacity of secreting substances of different chemical and physical properties according to definite laws, is the immediate cause of cell-formation and of every process of organic life."<sup>1</sup>

Each epithelial cell of the alveoli of the mammary gland is capable of forming in its interior one or more oil globules of varying size. These may and generally do run together, and, pressing the nucleus—which is a somewhat denser aggregation of the internal protoplasm—on one side of the cell, give to the latter the appearance of a fat cell.<sup>2</sup> And a fat cell it would probably become, and the whole mammary gland would in all likelihood undergo a conversion into a mass of adipose tissue, if the fat were not ejected from the epithelial cells, and particularly if, in these circumstances, the production of fat were exalted at the expense of the production of casein or of milk-sugar.<sup>3</sup> The fat can be seen to be gathered in the epithelium cell, and to be ejected by the cell protoplasm through the wall of the cell into the cavity of the alveolus. The cell resumes its former solid character, and begins again to form oil globules in its protoplasm, and the epithelial cells, so long as the secretion of milk is continuous, go on again and again forming globules of fat without being themselves destroyed.<sup>4</sup> Thus, the fat of milk, whose myriad globules have become confluent in every pat of butter, is formed in the microscopic epithelial cell through the metabolism<sup>5</sup> of its protoplasm. The fat-globules as brought into

<sup>1</sup> Sachs, "Text-book of Botany, Morphological and Physiological."

<sup>2</sup> Klein, "Elements of Histology."

<sup>3</sup> Foster, "Physiology."

<sup>4</sup> Langer, quoted by Klein, "Histology."

<sup>5</sup> Gr. *metabole*, change.

view in the microscopical examination of normal milk are seen to vary considerably in size, the largest ones being several times as big as an individual secreting cell from the epithelial lining of the alveolus. These large globules are produced by the fusion of the smaller ones after their expulsion from the alveoli, and during their passage along the lactiferous ducts.

The milk-sugar, or lactose, of the milk is, like the fat, also a product of the metabolic activity of the protoplasm of the secreting cells of the mammary gland. Of the exact mode whereby the protoplasm of the epithelium cell elaborates milk-sugar from the constituents of the blood, little or nothing is known, but that the formation of milk-sugar is effected by these cells is proved by the fact that this particular form of sugar occurs nowhere else in the animal body, though grape-sugar, or dextrose, is a normal constituent of blood, chyle, and lymph. Another proof is afforded by the circumstance, that although milk-sugar is a typical carbohydrate, its occurrence in the milk is not dependent on the presence of carbohydrates in the food, for it is maintained in abundance in the milk of carnivorous animals when these are fed exclusively on meat, a nitrogenous food as free as possible from any kind of sugar or other carbohydrate. Of all the constituents of milk, the milk-sugar is least influenced by external conditions.

With regard to the casein of the milk, is this also a product of the metabolic activity of the protoplasm of the secreting cell, that is, is it manufactured in and by this protoplasm, or is it simply separated from the blood? Here, again, evidence points to the former as the correct interpretation of the origin of the casein, for when the action of the secreting cells is imperfect, as at the beginning and at the end of lactation, the albumin which normally is less than one-seventh of the casein is actually in excess of it, and albumin—that particular variety known as serum-albumin—is a normal constituent both of blood and of milk. But when the secreting cells are in full activity, the casein comes prominently forward as the leading nitrogenous constituent of milk.

Certain physical peculiarities are associated with the presence of casein in milk. As has been demonstrated by Duclaux, casein is found in milk in two forms. It is partly in suspension, and on account of its different specific gravity this sinks to the bottom of a vessel of fresh milk left at rest. It is also, on the other hand, partly in a kind of gelatinised condition, in which state it remains diffused through the milk. These two forms of casein pass insensibly the one into the other, and although it is possible by rigorous methods to distinguish between them, yet there is no fundamental difference. That which is described as being in a gelatinous semi-liquid condition is, indeed, as much in suspension as is the other form, the proof of which is that if milk is filtered, not through a paper filter the pores of which are large enough to permit the passage even of granules of butter-fat, but across unglazed porcelain, the two forms of casein are



both arrested, and appear as a more or less coherent mass of gelatinous matter.

If to the liquid which passes through the porcelain filter a little acid be added, a white granular substance is separated which is still casein. Filtered through filter-paper and the clear liquid heated, another precipitate (albumin) makes its appearance. This albumin is regarded, however, by Duclaux, as simply a physical modification of casein. Milk contains, in fact, of albuminoid matter properly so called, only casein. But this casein exists really in three states,—in a state of perfect solution, capable of passing through a porcelain filter; in a state of mucous coagulation, uniformly diffused throughout the liquid; in a state of suspension from which when milk is left at rest it falls to the bottom of the liquid. For the sake of simplicity, and also because it is difficult to separately determine the quantities of the two last-named forms, Duclaux gives to these two collectively the name of solid casein, and he calls that which passes through the porcelain filter dissolved casein.

In normal samples of milk the proportion of solid casein is liable to variation, but the percentage of dissolved casein is always approximately the same. The weather, the temperature, the addition of water, the action of acids or alkalies employed in feeble proportions, of salts, &c., affect the latter little or not at all. The same is true of the action of rennet. It evades consequently all the operations to which milk is submitted in order to obtain therefrom its nutrient ingredients. In the manufacture of cheese, only the gelatinous casein and the casein in suspension are utilised. The action of rennet is to cause gelatinous casein to pass into the state of suspended casein,—that is, of curd easily separable from the serum or whey.

Experiments made by Thierfelder<sup>1</sup> lead him to believe that milk-sugar is produced from blood serum by the agency of a ferment which he calls saccharogen, though he has not succeeded in isolating this substance. Casein he regards as most probably formed from serum-albumin by an analogous ferment likewise present in the mammary gland.

Hence, we learn that the mammary gland, by the direct metabolic activity of its secreting cells, appears capable of forming, out of its protoplasm, typical representatives of the three great classes of food-stuffs, (1) proteids, albuminoids, or nitrogenous organic compounds represented by the casein and albumin, (2) carbohydrates represented by the milk-sugar, (3) fats represented by the oil globules. In other words, the secretion of milk may be regarded as “a process of moulting of the epithelial cells, which undergo decomposition, and discharge the resulting products into the excretory ducts.” But, in order to discharge this complex function, the protoplasm must be nourished; wonderfully capable as it is, it yet would be powerless to do the work which living matter alone can do were it not furnished with the material with which to operate. And this material is abundantly, almost lavishly, supplied to

<sup>1</sup> “Biedermann's Centralblatt für Agricultur-Chemie,” 1884.

it by the blood, for every alveolus in the mammary gland is surrounded by a dense network of blood capillaries, and the exceedingly thin walls of these as well as of the secreting cells are easily permeable by fluid. As has already been indicated, the blood is dependent for its nourishment upon the food.

Reverting now to the formation of fat by the secreting cells of the mammary gland, the mechanism of this process may perhaps be better understood by studying analogous, though not strictly similar, processes which are observed to occur, firstly, in a certain low form of animal life, named *Amœba*, and, secondly, in the epithelial cells of the intestinal villi during the absorption or appropriation of fat. *Amœba* is a minute microscopic organism which may be found in stagnant water, or in aqueous infusions of animal matter. It has very much the appearance of a particle of jelly, it consists almost entirely of protoplasm, and is continually changing its form. A nucleus is often present. The gelatinous body of the *amœba* can hardly be regarded as possessing a distinct external covering, though the circumferential part does differ in some minor details from the deeper-lying portions. This limitary layer has been aptly compared to the wall of a soap-bubble, which, though fluid, has a certain cohesion which not only enables its particles to hold together and form a continuous sheet, but permits a rod to be passed into or through the bubble without bursting it; the walls closing together, and recovering their continuity as soon as the rod is drawn away. In a similar way the *amœba* feeds, taking in and passing out solid matter, though the animal possesses no aperture; the solid body passes through the outer wall, which immediately closes up and repairs the rent. Thus does the *amœba* take in the small, usually vegetable, organisms, which serve it as food, and subsequently get rid of the undigested solid parts.<sup>1</sup> From the food thus obtained the organism can make new protoplasm, and produce other organisms like itself. It lives, moves, eats, grows, and after a time dies, having been during its whole life hardly anything more than a minute lump of protoplasm. Certain substances serving as food are received into the body of the *amœba*, and there in large measure dissolved. The dissolved portions are subsequently converted from dead food into new living protoplasm, and become part and parcel of the substance of the organism. Simultaneously there is going on an ejection of old material, for the protoplasm is incessantly undergoing chemical change (metabolism), room being made for the new protoplasm by the breaking up of the old protoplasm into products which are cast out of the body and got rid of. These products of metabolic action have, in many cases at all events, subsidiary uses. Some probably serve to dissolve the raw food introduced into the *amœba*, and remain in its body for some little time for this purpose. Such products are generally called secretions; others which pass more rapidly away are spoken of as excretions. The distinction between the two is unimportant and frequently accidental.<sup>2</sup>

In the case of the intestinal villi, it is absolutely certain that the

<sup>1</sup> Huxley, "Practical Biology."

<sup>2</sup> Foster, "Physiology."

finely divided fat does pass from the intestine, through the epithelial cells which envelope the villus, and so into the channel of the lacteal. Most observers agree that after a meal the epithelium cells of the villus are gorged with fat, the particles of which must have entered the cells very much as foreign particles enter the body of an amœba. The cells may thus be said to eat the fat, and subsequently to pass it on in the direction of the channel of the lacteal. There would thus be a stream of fatty particles through the cell, a stream in the causation of which the cell took an active part. In fact, under this view, absorption by the cell might be regarded as a sort of inverted secretion, the cell taking much material from the chyme and secreting it with little or no change into the villus.<sup>1</sup>

Professor E. A. Schäfer has actually demonstrated in his paper, "On the origin of the proteids of the chyle and the transference of food materials from the intestine into the lacteals,"<sup>2</sup> that lymph corpuscles play an important part as carriers of fat into the lacteals of the villi. They take up, amœba-fashion, the fatty particles from the epithelium cells of the villi, and thus fat-laden they wander towards the centre of the villus and enter the lacteal, inside which the coat of the migratory lymph cell is dissolved and its contained fat set free. It is particularly worthy of note that migratory or lymph corpuscles occur in the tissue between the alveoli of the mammary gland.

Considerations such as the foregoing lead to the splendid generalisation that the epithelial cells of the villi, the secreting cells of the mammary gland, and the colourless corpuscles of the blood, may be regarded as amœbæ,—that, in fact, the whole animal body may be viewed as groups of amœbæ, associated together for many and varied objects, the different groups exhibiting specialisation of structure in accordance with the nature of the work they are respectively called upon to perform, the functions of one group differing from those of another in conformity with the strict physiological division of labour which is an inevitable condition of existence, if the aggregation of cells is to exhibit any characters of a higher order than those which belong to the cell as an individual.

A comparison of the epithelial cells of the villus with those of the alveoli of the mammary gland seems to bring under notice a similarity of behaviour with respect to the disposal of the particles of fat with which they, in each case, become laden. In the former case the globules are ejected into the interior of the villus; in the latter case, they are ejected into the cavity (or lumen, as it is called) of the alveolus, and in both cases the mechanical action is comparable with that whereby an amœba ejects from its body such matters as it has no further use for. In all other respects, however, the epithelial cells of the mammary gland possess functions of a far more exalted order than those of the epithelial cells of the villi, for the former actually manufacture the fat they contain out of the blood they

<sup>1</sup> Foster, "Physiology."

<sup>2</sup> "Proc. Roy. Soc.," No. 235, 1885.

receive, while the latter apparently take up ready-made fat and pass it on. Moreover, the mammary secreting cells are further capable of elaborating milk-sugar and casein out of the constituents of the blood.

At the beginning and at the end of lactation, and equally during the suspension of that function, the mammary gland presents features which well deserve study. The resting-gland, that is, the gland of a non-pregnant or non-suckling animal, contains fewer alveoli than the active gland, but a great deal of fibrous connective tissue. The alveoli, too, are at this period solid cylinders with no internal lumen, but during pregnancy these solid alveoli rapidly multiply, lengthen, and thicken, owing to the division of the epithelial cells. When milk secretion commences, the cells occupying the central part of the alveolus

undergo the fatty degeneration, and are at once excreted. It is the presence of these cells which imparts to the milk, for several days after calving, the peculiar properties in virtue of which it is called colostrum, or colostrum (figs. 69 and 70). The central cells of the alveoli are appropriately termed colostrum corpuscles, and their elimination provides the cavity, or lumen, inside each alveolus, into which the fat globules formed in the peripheral epithelial cells are ejected. The peripheral cells, it is to be noticed, do not sacrifice their position like the central ones, or there would be none left for the work of secretion; but Schmid asserts that even these finally break up," one by one, and

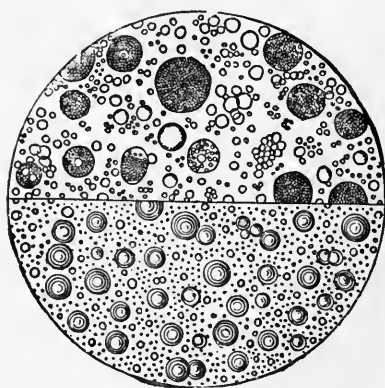


Fig. 69. — Microscopic appearance of Milk and Colostrum (*Landois*).

The lower half of the figure represents milk; the upper half colostrum.

are replaced by new epithelial cells derived from the multiplication of the other still active ones. The small bits of granular substance met with here and there in milk are the remains of the worn out and broken down protoplasm of such epithelial cells.<sup>1</sup>

The deep yellow colour, unctuous character, and higher specific gravity of colostrum are thus readily explicable. Fürstenberg thought that the pieces of membrane and clusters of cells which appear in this early mammary fluid were milk globules in a state of transition, that is, not yet perfectly formed.<sup>2</sup> But now they are known to be the degraded fat-laden cells of the axial region of the alveolus, which must, as it were, be cleared for action before the mammary gland can attain its full secretory power. The reason, too, that milk drawn within the first week after calving should never be used for making cheese is that such milk contains in relative abundance actual animal matter derived

<sup>1</sup> Klein, "Elements of Histology."

<sup>2</sup> Sheldon's "Dairy Farming."

from the debris of the central cells of the alveoli, and the presence of this animal matter must seriously interfere with the ripening of the cheese. The percentage of this material is, of course, largest at first, and steadily diminishes.

Colostrum is defined by Dr. Meade Smith, in his "Physiology of the Domestic Animals," as an opaque, yellowish fluid, containing a large amount of the so-called colostrum cells (true glandular cells in different stages of fatty degeneration), few milk globules, a large amount of albumin, little or no casein, and but little fat, milk-sugar, and salts. On account of its large percentage of albumin it coagulates when

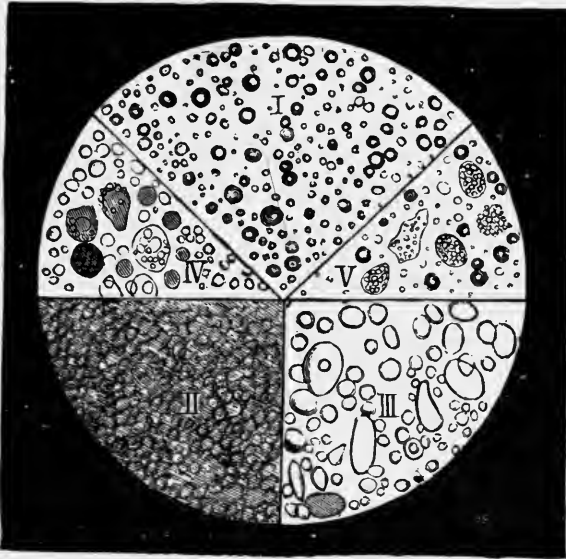


Fig. 70.—Microscopic appearance of (i) Milk, (ii) Cream, (iii) Butter, (iv) Colostrum of Mare, (v) Colostrum of Cow (*Thunhoffer*).

heated, differing in this respect from milk ; in fact, colostrum when first secreted closely resembles blood-serum, with the addition of colostrum corpuscles. Gradually, however, the colostrum secretion passes into a milk secretion ; albumin and colostrum corpuscles become reduced in quantity ; fat, casein, sugar, and milk-globules increase. The specific gravity of colostrum varies from 1040 to 1060, being higher immediately after delivery, and falling as it gives place to a true milk secretion. The reaction of colostrum is ordinarily alkaline, and becomes acid on standing. Immediately after calving, the colostrum of the cow contains 8.5 per cent. of albumin, after one day 6.4 per cent., after three days 3.4 per cent., after seven days 1.9 per cent., and after twenty-one days 0.6 per cent. On an average colostrum may be said to have the following composition :—

Water . . . . .	78.7
Casein . . . . .	7.3
Albumin . . . . .	7.5
Fats . . . . .	4.0
Sugar . . . . .	1.5
Salts . . . . .	1.0
	<hr/>
	100.0

The source of the water of milk must undoubtedly be sought in the water of the blood. As has previously been stated, the sanguineous fluid oozes through the finest blood capillaries in all parts of the body, and in most parts of the system this overflow is kept under control by means of the lymphatic vessels which collect the thin fluid, now known as lymph, and return it to the heart, though in most cases the lymph passes through the thoracic duct on its way to the central organ of circulation. The thoracic duct, it will be remembered, also receives the chyle collected by the lacteals, or lymphatics of the intestine, and it is estimated that in the course of twenty-four hours a quantity of fluid equal to that of the blood is thus poured into the duct on its way to the heart, about one-half of this fluid being lymph and the remainder chyle. Lymph is a pale yellowish fluid, containing from 94 to 95 per cent. of water, and may be regarded as blood deprived of its red corpuscles and diluted with water, while chyle may be described as lymph containing much fatty matter. The great distension which the mammary gland undergoes, as it becomes stocked with milk, is chiefly due to the accumulation of water, the presence of which is necessitated as a vehicle whereby the other constituents of the milk may be conveniently taken up and carried away. The copious supply of blood, in the capillaries which surround each alveolus of the mammary gland, is most favourably circumstanced for giving up its aqueous material through the moist delicate membranes by which it is enclosed; any watery fluid which did not go to swell the excretion of milk would find its way amongst the tissues constituting the framework of the gland into the lymphatics, and so back by way of the thoracic duct into the blood. The kidney affords another example of an organ whose secretion, mainly nitrogenous in this case, is mingled with much water and converted into an excretion.

It is important to remember that the mammary gland of the cow, particularly in such favourite milking breeds as the Jerseys, the Ayrshires, and the Dutch, has been brought into a condition of abnormal activity differing as much, perhaps, from the gland in its unimproved condition, as does the large shapely root of a cultivated turnip from that of its wild progenitor. The duration of lactation has been extended, the quantity of the lacteal fluid has increased. Moreover, the quality of the milk is found, within certain limits, to vary under different conditions, the percentage of water sinking at times to as low as 84, and rising to as much as 90. It is a legitimate and useful object of inquiry as to how far this kind of variation can be controlled, and particularly as to what extent it can be modified with economical advantage.

The morning milk usually contains from  $\frac{1}{2}$  to 1 per cent. more water than the evening milk, but on the other hand there is generally more of it. This is attributed to the fall of temperature during the night, which would necessitate the oxidation of more carbonaceous material to keep up the body warmth, and to the lessened activity of the animal. But Fleischmann and Vieth<sup>1</sup> experimenting on Count von Schieffen's Mecklenburg herd of 119 cows, found not only that the proportion of fat in the evening oscillated within wider limits than in the morning, but they also observed that from March to July, the period of greatest activity of the mammary gland, the morning milk was richer in fats than that of the evening, the cows being pastured on common land at the time. It is interesting to note, too, that the annual yield of milk of this herd was, for each cow, 5.69 times its own live weight. That the fat, though represented by a smaller percentage in the morning milk, may yet be present in greater absolute quantity is shown by the following average results obtained by the same experimenters<sup>2</sup> after a year's examination of the milk of several cows:—

	Morning milk.	Evening milk.
Specific gravity . . . . .	1.0316	1.0318
Percentage of fat . . . . .	3.374	3.420
Yield per cow in pounds . . . . .	7.814	7.566
Yield of fat in ounces . . . . .	4.224	4.083

The differences in the milk drawn at the beginning and at the end of milking have been studied by Schmidt,<sup>3</sup> who employed a middle-aged Dutch cow giving twenty-one imperial pints daily. A measured quantity (seven-eighths of a pint) was taken from the two hinder teats at the commencement of the morning milking, and an equal quantity at the end of the same milking. One hundred parts by weight of the milk contained:—

	First milk.	Last milk.
Total solids . . . . .	9.20	13.64
Albuminoids {	Casein . . . . .	2.24
	Albumin . . . . .	0.31
	Peptone . . . . .	0.10
Fat . . . . .	0.76	5.60
Sugar . . . . .	5.08	4.92
Ash . . . . .	0.69	0.66

Thus, the difference in the quantity of the total solids is almost entirely in the fat, which is between seven and eight times more abundant in the last than in the first milk. The explanation offered is, that the fat at first lodges in or adheres to the lactiferous ducts, and that a separation of cream begins in the udder, and this would, as far as circumstances permitted, seek to float on the denser fluid aggregated at the base of the teats. The udder of a cow killed immediately after milking showed, on examination, that the ducts contained a residue of rich milk. Excepting the fat, the great bulk of the milk secreted by a

<sup>1</sup> "Landwirthschaftliche Versuchs-Stationen," vol. xxiv.  
<sup>2</sup> "Bieder. Centr.," 1880.  
<sup>3</sup> *Ibid.*, 1883.

cow appears to possess a tolerably uniform composition, but the whole of the fat is rarely obtained in the milking.

Though much locomotion is detrimental to the yield of milk, it is a mistake to suppose that uninterrupted confinement in the stall is the most economical treatment for a milch cow. With moderate locomotory exercise the slight reduction in quantity of milk appears to be fully compensated for by the increased yields of solids. Munk,<sup>1</sup> to settle this point, experimented with thirty cows, and found that when they were allowed half an hour's daily exercise, the total quantity of the milk as well as the fat and casein increased, though much exercise exerted an adverse influence on the yield. When cows are on grass, their increased appetite in the presence of abundance of food quite makes up for any loss incurred in the movements necessary to obtain that food. Hence it is desirable that stall-fed milch cows should have daily exercise.

It is, in a sense, due to a mere physiological accident that the fat elaborated in the organs of a milch cow is excreted rather than stored up in the system. And the metabolic activity of the secreting cells of the mammary gland is closely connected with the exercise of the maternal functions. We are utterly in the dark, says Dr. M. Foster, as to why the uterus, after remaining apparently perfectly quiescent for months, is suddenly thrown into action, and within, it may be a few hours, gets rid of the burden it has borne with such tolerance for so long a time. After birth, the maternal energy, previously occupied in nourishing the fœtus, is now directed to the secretion of milk, whereby the nourishment of the offspring may still be maintained.

Though it may be physiologically possible for a cow to give a copious flow of milk, and simultaneously to undergo a marked increase in weight, nevertheless, these two effects are generally in an inverse ratio to each other. Thus, it is a characteristic of individual cows, and in some cases of entire breeds, as the Herefords, the Galloways, and the Aberdeen Polls, to lay on flesh rather than to make milk. Of the causes which determine such idiosyncrasies little or nothing is known, just as little or nothing is known as to why the same food, given freely to a wether and to a steer, should be converted into mutton in the one case, and into beef in the other. It is the duty of the breeder to discover these and other idiosyncrasies, and to endeavour to perpetuate them, if they appear to be desirable. In an insufficiently fed or starving animal, the first demand the system makes is on the fat stored up within it, so that a starving ox feeds as much on animal matter as does a lion. Similarly, in a milch cow, the first effect of insufficiency of food is the falling off in the amount of fat secreted by the mammary gland. Nor can this secretion become at all marked in quantity till all the other physiological requirements of the body have been first attended to. This was very well exemplified in the case of a two-and-a-half year old Southdown ewe experimented upon by Weiske.<sup>2</sup> The ewe lambed on April 22, and was regularly milked three times daily, receiving at the

<sup>1</sup> "Bieder. Centr.," 1884.

<sup>2</sup> "Bieder. Centr.," 1880.



time 1 lb. hay, and 1 lb. oats per day together with turnips. The weight of milk she gave each day from the beginning of May was :—

Date . . .	1st	2nd	3rd	4th	5th	6th	7th	8th	9th
Grams. . .	523	620	736	768	840	910	924	992	987

From May 10 to May 20 there was a very regular daily yield of 1,000 grams. On May 21 the ewe was shorn, and, notwithstanding the continuance of the same food and treatment, the following falling off in yield was recorded :—

Date . . .	20th	21st	22nd	23rd	24th	25th
Grams. . .	1006	913	854	781	750	712

The meaning of this is obvious. The removal of the wool necessitated the immediate consumption of more food to maintain the body warmth ; the rations served out to the animal remained the same, and consequently the production of fat had to suffer, and this loss fell on the secretion of the mammary gland. On May 26, however, ½ lb. of linseed cake was added to the other food, and the following yields of milk were measured :—

Date . . .	26th	27th	28th	29th	30th	31st
Grams. . .	687	760	889	950	910	961

Thus the decrease in the yield which resulted from the shearing, was made good by adding an appropriate quantity of linseed cake to the daily food of the ewe.

To some extent in this country, but more especially in countries where, as in Canada, the contrast between summer and winter is more marked, an error is made in the underfeeding of cows that are not in milk. Exposure to the winter’s cold causes a larger demand to be made upon the food for its heat-giving properties, so that with the same amount and quality of food, less milk can be expected in winter than in summer ; this necessity for increased food in colder weather may, however, be largely met by warm and comfortable housing. It is a blunder, both economically and physiologically, to imagine that if cows are just kept alive through the winter, all that is necessary has been done. On the other hand they need to acquire in winter a reserve of health and of flesh, which they can fall back upon in summer, when the flow of milk should be most copious. The frequent drying up of pastures towards the end of summer must be met by an extra supply of food, otherwise the milk-secreting function will be much impaired, for, as has been shown, it is quite subservient to other demands of the body.

Related in some degree to the change from winter to summer feeding is the not yet thoroughly understood occurrence of “lazy” or “heavy” milk, so called because of the apparent reluctance with which the cream separates. As complaints of lazy milk are generally most numerous at about the time when the cows begin grazing, Schrodtt and Du Roi,<sup>1</sup> imagining that the sudden change from the dry hard feeding of the

<sup>1</sup> “Bieder. Centr.,” 1880.

stalls to the tender soft herbage had something to do with the complaint, caused a herd of milch cows to be fed with green food previous to their going out on grass, commencing with small quantities of green fodder, and gradually increasing this until it had wholly replaced the other. The experiment extended over a fortnight, and at its close the animals were put out to grass, but there were no complaints of lazy milk. Hence, the abrupt change from dry to green fodder appears sometimes to result in lazy milk, but why this should be so is not known. Generally speaking, sudden and abrupt changes from one kind of feeding to another should always be avoided, not on account of the milk only, but for general considerations relating to health.

It might be supposed that the more fat a food was found, on analysis to contain, the richer would be the milk resulting from the consumption of that food. But this is a generalisation not altogether warranted by facts. Foster<sup>1</sup> significantly observes that the quantity of fat present in milk is largely and directly increased by proteid (*i.e.*, nitrogenous) food; but not increased, on the contrary, diminished, by fatty food. The explanation of this is, that proteid food increases, and fatty food diminishes, the metabolism of the body; in other words, that it is the nitrogenous constituents of the food-stuffs which excite the activity of the living cells on whose protoplasm the maintenance of the functions of the body is dependent. A bitch fed on meat for a given period gave off more fat in her milk than she could possibly have taken in her food, and that too while she was gaining in weight, so that she could not have supplied the mammary gland with fat at the expense of fat previously existing in her body; she probably obtained it ultimately from the proteids of her food. (It must be borne in mind that the proteids, carbohydrates, and fats of animal food all contain carbon, hydrogen, and oxygen, but that the proteids differ from the other two classes in also containing nitrogen; an animal could be kept alive on proteids alone, but not on fats and carbohydrates either separately or together,—a dog fed exclusively on pure fat would die of starvation.) More than five-and-twenty years ago, Lawes and Gilbert proved by direct analysis that for every hundred parts of fat in the food of a fattening pig, four hundred and seventy-two parts were stored up as fat during the fattening period, so that it is evident that fat is formed in the body out of something which is not fat. And Liebig had previously proved that the butter present in the milk of a cow was much greater than could be accounted for by the scanty fat present in the grass or other fodder she consumed. There is overwhelming proof that fat is formed anew in the animal body, for two animals fed on the same food will each store up the special kind of fat peculiar to itself. Moreover, dogs fed on foods consisting largely of different fats will exhibit but little variation in the composition of the fat they store up: Subbotin found that a dog fed after a preliminary starvation period, with one thousand grams of spermaceti, of which he absorbed at least eight hundred grams, nevertheless yielded but the merest trace of spermaceti in the fat of his body.

<sup>1</sup> "Physiology."

There is, finally, abundant evidence for concluding that the carbon of the newly-formed fat, equally in the milk of a cow as in the body of an ox, may be supplied (1) from the carbohydrates of the food, or (2) from the carbon surplus of the proteid food, or (3) from fats taken as food which are not the natural constituents of the body-fat.

If the butter fats of milk were derived directly from the food, and transferred without change to the milk, it would be possible to control, through the food, the quality and composition of the butter produced. This was once regarded as possible because such plants as onions and turnips impart, in a short time, characteristic odours to the milk of the cows consuming them; whilst the marked difference in colour and flavour of butter made in the winter when the cows receive only dry food, and in the summer when grazing, has been attributed to differences in the fatty portion of the fodder. On the other hand, variations in the composition of butter ascribed to breed and to individual peculiarities of the cow, are so well defined and so constant, whatever the character of the food, as to render a direct transfer of fats highly improbable. The question of the essential oils of plants is rather beside the point; a peck of onions fed to a cow would scarcely impart so much flavour to the milk as would a piece of onion directly added to it.

One way of elucidating the question is by carefully examining the butter, and noting the changes in its composition which follow radical changes in the food. Crude cotton-seed oil has some characteristic properties by which its presence, when mixed with butter, even in small quantities, may be detected. A cow whose butter had frequently been tested was set apart at the New York Experiment Station, and cotton-seed meal included in her food. The first cotton-seed meal was given on April 18, half a pound, and the quantity gradually increased to 4 lb. on May 1. This amount of meal contained as much fat as the remainder of the ration, and would therefore be likely to contribute an appreciable amount of cotton-seed oil to the butter, if any direct transfer does occur. Inasmuch as the soaps from crude cotton-seed oil have a high viscosity, whilst those from butter fat are usually low in this respect, the test of the viscometer was applied time after time, with the result that, notwithstanding the change in ration, no appreciable change in the viscosity occurred; this was strong evidence that no cotton-seed oil was transferred to the butter. Nor was any cotton-seed oil detected in the butter when subjected to another delicate and reliable test for the presence of the former. In this case, for certain then, there was no transfer of cotton-seed oil from the food to the milk.

The same thing is shown by the constant and uniform difference found in butters from different breeds of cows, and from individual cows in the same herd all receiving the same food and attention. From such data Dr. Babcock concludes that the composition of the butter fats is practically constant for each individual cow under all circumstances of normal feeding. As a matter of fact, quality of butter depends more upon certain physical properties and flavours, which constitute scarcely more than traces of the butter, and which as yet have not even been

identified by chemists, than upon the fixed oils which compose it. Nevertheless, these principles, as well as those which determine the colour of butter, are unquestionably influenced by food and treatment. The question remains, How?

When cows are largely fed on watery herbage, brewers' grains, or other food containing a high percentage of water, the milk becomes poorer in solids, or, in other words, the proportion of water in the milk increases. This probably arises from the more watery, or poorer, character of the blood, for water taken into the stomach is absorbed almost immediately by the blood capillaries and lymphatics in the walls of that organ, as is proved by the instant alleviation of thirst when water is drunk. A course of poor watery diet, then, impoverishes the blood, and poor blood leads to the production of poor milk in the mammary gland—of milk, that is, which contains a larger percentage of water than would be the case with better food.

Both the secretion and the excretion of milk are under the control of the nervous system, but the exact mode whereby the nervous influence is exerted remains to be worked out. Indirectly, however, the secretion of milk must be largely affected through the sympathetic nervous system, whose centre is in a chain of nervous elements extending along the general body cavity just beneath the backbone. This system is distinct from, though connected with, the brain and spinal cord, and it largely contributes to, amongst others, the vaso-motor nerves. These nerves are so called because they are connected with the muscular walls of the blood vessels, and, through their influence on the vascular muscles, determine whether the calibre of the vessels shall be increased or diminished; through them, therefore, the quantity of blood which flows along an artery in a given time is regulated. Thus, undue exposure to cold produces an effect on the skin which is conveyed to the nervous centres, the vaso-motor nerves consequently experience a partial paralysis, and are therefore incompetent to control the arterial muscles in one or more organs of the body. The arteries lose their normal tone, more blood passes through them than is compatible with health, that undue distension of the blood vessels known as congestion is set up, and inflammation is the usual result. It may not be the mammary gland, but the lungs or intestines, which are the direct sufferers, nevertheless, the mammary gland is bound to show the effects of such adverse influences in its smaller and poorer secretions. And it is not unlikely that a similar result is more directly produced when undue stimulation of the vaso-motor nerves which control the arteries of the mammary gland leads to an abnormal constriction of these vessels, and so reduces the supply of blood to the secreting cells. In the case of the kidney, indeed, it has been proved, that any irritation of the nerves which control the muscular walls of the blood vessels supplying the organ has the immediate effect of stopping the excretion of urine. But the sympathetic nerves are further of interest in being those through which any unkind treatment of the cow, wilful or otherwise, is bound to show its effect in diminished yields of milk. Ill ventilated, badly drained, or too draughty cow-houses, careless exposure to bad

weather, irregular feeding, brutal usage, fast driving, the mad rushing about provoked by the attacks of the ox warble fly, and a variety of other causes, are bound to exert an influence upon the nerves, the effects of which will be unerringly recorded in the milk-pail.

The familiar comparison of a cow to a steam-engine is obviously hardly a fair one. Fuel is supplied to the engine, and work is got out of it; the cow receives food and yields milk; and if the engine be debited with fuel and the cow with food, and the former be credited with work and the latter with milk, this is about as far as the comparison can safely be carried. The intimate and essential relation which is set up between the food of the cow and the structure and composition of the animal is of an order vastly superior to that which exists between the fuel of the engine and the inanimate parts which are set in motion, without undergoing any necessary internal change, as a result of the oxidation of that fuel. In estimating the efficiency of a steam-engine, it is quite sufficient to compare the power theoretically deducible from the complete oxidation of the fuel with that exerted at the driving point on the resistance to be overcome; the difference between the two, shows the loss due to friction and other causes. But, as Sir J. B. Lawes has pointed out, in estimating the milk-producing capacity of a cow, as shown by comparing the amount of food consumed with the quantity of milk yielded, the live weight of the animal is an important element to be considered, particularly in cases wherein the performances of different cows have to be compared. Were the cow a rigid machine like the steam-engine, and were her milk-producing work effected simply by her mechanically receiving food at one place and discharging milk at another, her weight then would be a matter of secondary and trivial importance. But it is obvious that in the cow not only the absolute live weight, but the percentage increase during lactation, should enter as factors into any problem concerned with estimating and comparing the milk-yielding capacities of different animals.

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## CHAPTER V.

### OF THE MANAGEMENT OF MILK AND CREAM, AND THE MAKING AND PRESERVATION OF BUTTER.

“MILK is an opaque fluid secreted by the mammary glands of the females of animals belonging to the class Mammalia, and adapted to the nourishment of their young. It is of a specific gravity somewhat greater than that of distilled water.”

The average composition of the milk of the cow may be stated to be:—

Water . . . . .	87·05
Casein (pure curd) . . . . .	3·50
Butter . . . . .	3·70
Milk sugar . . . . .	4·60
Albumin . . . . .	0·40
Ash . . . . .	0·75
	<hr/>
	100·00

and in extreme instances it may vary from :—

Water . . . . .	80·00 to 90·00 per cent.
Casein . . . . .	3·00 ,, 5·00 ,,
Butter . . . . .	1·80 ,, 5·20 ,,
Milk sugar . . . . .	3·00 ,, 5·50 ,,
Albumin . . . . .	0·30 ,, 0·55 ,,
Ash . . . . .	0·70 ,, 0·80 ,,

“Neither casein nor butter is in solution in milk, but rather in suspension—the butter-fat expressly so. Casein appears to be in the form of an extremely attenuated jelly, owing to lavish absorption of water; but it is not dissolved, or it would pass the membrane of a dialyser. It is soluble in diluted hydrochloric acid, or carbonate of soda, and it is coagulable by rennet, and by lactic acid, and may be precipitated by various acids. Coagulation by rennet, which is the active agent of digestion in the fourth stomach of a calf, is the only form of coagulation that can be employed in cheese-making, for it is the digestive agent alluded to which has so much to do with ripening and mellowing the cheese after it is made.

“Butter-fat, in the form of cream-globules, is easily seen by the aid of a microscope to be in suspension in milk, and each globule is a separate entity. These globules belong to the ‘infinitely little’ in Nature, for a single pint of milk, containing 4 per cent. of cream, has been estimated to contain no less than the prodigious number of forty thousand millions of them! The diameters of the globules vary a good deal in all milk, and in the milk of different breeds of cows, or in that of different cows of the same breed, sometimes. Sturtevant gives them at  $\frac{1}{4440}$  to  $\frac{1}{5520}$  of an inch. Milk, indeed, is an emulsion, in which the most valuable ingredient is butter-fat. The specific gravity of milk containing all its cream is about 1·032, whereas that of butter-fat is about ·90, water as a standard being 1·00; and it is this difference in specific gravity which causes cream to rise to the surface of milk that is at rest. Some of the cream-globules, however, have the peculiarity of being stationary, while others appear to gravitate slowly downwards, and hence it is that the whole of them never succeed in reaching the surface of the milk.”<sup>1</sup>

Milk from which the supernatant fluid or cream has been removed, is termed skim-milk, and still retains a considerable quantity of coagulable or caseous matter, which may be separated from the serum or whey, by means of a rennet or some acid. This coagulated portion constitutes the curd, and is the basis of cheese. If a rennet be used, and all the portion coagulated by its means be separated, the addition

<sup>1</sup> “The Farm and the Dairy,” by J. P. Sheldon, pp. 59, 60.

of vinegar will cause a portion of what was left to coagulate. What remains after both of these coagulated principles have been removed is *whey*, containing sugar of milk, some nitrogenous substance, lactic acid, and various salts.

Some exact information upon the composition of milk is given by Dr. Paul Vieth, Analyst to the Aylesbury Dairy Company, in an elaborate paper published in the "Journal of the Royal Agricultural Society of England," vol. xxv., 1889. He discusses the results of analyses of no less than 84,746 samples of milk, made during a period extending over eight years. The samples analysed were the produce of herds kept upon English dairy farms, and Dr. Vieth records the results in a series of diagrams indicating the total solids, the non-fatty solids, and the fat, according to the monthly averages of eight years. It is premised that the total solids include everything that is valuable in milk; the fat must, in several respects, be considered the most valuable component part; and the percentage amount of non-fatty solids is of particular importance as being the most constant factor, and, therefore, best adapted to serve as a guide to the genuineness and purity of the milk. It is hardly necessary to remind our readers of the fact which may be tersely expressed, so far as milk is concerned, thus:—

$$\text{TOTAL SOLIDS} = \text{NON-FATTY SOLIDS} + \text{FAT.}$$

Dr. Vieth finds, as the result of many analyses, that 12 parts of the non-fatty solids are thus made up on the average:—

Milk sugar . . . . .	6
Mineral matter, or ash . . . . .	1
Nitrogenous matter, or proteids . . . . .	5
	12

Of the nitrogenous matter rather more than two-thirds consists of casein, the specific component part of cheese. From the foregoing figures is calculated the following average percentage composition of the non-fatty solids of milk:—

Milk sugar . . . . .	50
Mineral matter, or ash . . . . .	8½
Nitrogenous matter, or proteids . . . . .	41½
	100

The average composition of all the milk received at the Aylesbury Dairy Company's premises at Bayswater indicates a great uniformity in the quantity of non-fatty solids, and a rather marked variation in the percentages of fat, with, of course, a concomitant fluctuation in the amount of total solids. Towards the end of the year—more particularly in November—the milk attains its highest quality, while in the spring months the poorest milk is received, another diminution in quality frequently occurring in July. Of these fluctuations Dr. Vieth offers the following explanation:—In autumn the majority of cows are stale, and they then give a limited quantity of milk, which is of high





		Shorthorn.	Jersey.	Kerry.
Morning	Non-fatty solids . . . . .	9.0	9.6	9.2
	Fat . . . . .	3.5	5.1	4.0
	Total solids . . . . .	<u>12.5</u>	<u>14.7</u>	<u>13.2</u>
Evening	Non-fatty solids . . . . .	9.1	9.6	9.3
	Fat . . . . .	4.4	6.3	5.1
	Total solids . . . . .	<u>13.5</u>	<u>15.9</u>	<u>14.4</u>

The points of interest here are the enormous richness of the milk of the Jerseys, and not less the high quality of that of the Kerries, which latter certainly surprised many dairy farmers.

The great uniformity of the specific gravity of milk is very noteworthy. In the case of the mixed yield of a large number of cows it rarely falls outside the limits of 1.030 and 1.034 (water being 1.000). In view of the considerable variations in composition which obtain between, for example, Shorthorn and Jersey milk, this may seem remarkable, but the circumstance is readily explained by the fact that the higher percentage of fat, which tends to lower the specific gravity, is usually associated with an increased amount of non-fatty solids, which exercise an influence in the opposite direction. Though larger variations certainly do occur in the milk of individual cows, yet in the 1,652 samples of Shorthorn, Jersey, and Kerry milk to which reference has been made, only 50 samples registered a specific gravity below 1.030, and only 73 samples—notably of Jersey milk—gave a specific gravity above 1.034. By far the greater number of these exceptional specific gravities were not below 1.029, nor above 1.035; though the lowest actually observed was 1.0240, and the highest was 1.0365.

The quality of milk greatly depends on the quantity which the cows will yield and the nature of the food, but most of all on the breed of the cows. The quantity is, to a certain degree, influenced by the manner in which the cows are milked; and it behoves every dairy-man to pay a little more attention to this important process than he is generally accustomed to do. If a cow is roughly handled, it is not only painful to her, but will also cause her to withhold a portion of her milk; whereas, if it is gently drawn, she will yield it freely. It is of importance that it should be drawn to the last drop, for although we do not pretend to believe what has often been asserted, viz. that the last half-pint is richer in cream than the whole of the rest, we fully admit that whatever milk is left in the udder is liable to coagulate and injure the udder, as well as to lessen the subsequent “meals of milk.” It sometimes happens that the cows are restless and fidgety; but they should by no means be harshly or severely treated at such times. If the udder is hard and painful, it should be fomented with lukewarm water, and gently rubbed, by which simple expedient the cow will generally be brought into good temper, and readily yield her milk. It is also proper to feed the cows at the time of milking, for, while eating, they give out their milk with greater freedom. They are also prevented, by the motion of their jaws, from the habit, which some acquire, of with-

holding their milk, and which, if it be not properly prevented, will soon cause them to become dry.

In this country, it is the general practice to milk cows twice in the course of twenty-four hours throughout the year; but in summer the proper periods may be three in every day, and at intervals as nearly equidistant as possible, viz. very early in the morning, at noon, and a little before the approach of night. It is a well-known fact that cows, when milked thrice in the day, yield more in point of quantity, and milk of as good, if not better quality, than they will give under the common mode of milking them only in the morning and evening. Very particular directions should be given that the cows be driven slowly to the place of milking. If they are hurried in ever so slight a degree, the separation of the milk into its constituent parts will not so readily or perfectly take place. On this account, if the pasture is at a considerable distance, it may, perhaps, be better to milk them in the field than to drive them home. If cleanliness were attended to as much as it ought to be, the udder and teats would be washed with a sponge and water, or preferably dry-rubbed, before the milking commenced.

After the milk is drawn from the cow, it should be carefully strained through a gauze or linen cloth, stretched on an open-bottomed wooden bowl or milk-sieve, into the cream-pans, which should never exceed three inches in depth, although they may be made so wide as to contain any quantity required. The milk-pail should then be rinsed with about a quart of cold water, which also may be poured through the sieve into the milk-dish. If any ill flavour is apprehended from the cows having eaten turnips, &c., the addition of one-eighth part of boiling water to the milk, before it is strained into the dishes, will in a great degree tend to remove it, or the solution of nitre may be used, as already recommended. These pans, when filled, should be set upon the shelves, there to continue until the cream is removed.

“The question of temperature naturally influences the absorbent capacity of milk, for so long as the milk is warmer than the atmosphere of the room, it gives off rather than attracts odours. Cold air coming in contact with warm milk is expanded and rises, and its capacity for holding gases, vapours, and odours is increased, so that it attracts volatile odours from the milk, and may even be made to purify it to some extent, particularly when the milk is stirred about a good deal. And hence it follows that a low atmospheric temperature is the best for the milk-room; but when the temperatures of the milk and of the room are equal, or when that of the milk is the lower, the milk-pans are better covered over to shut off free contact with the air. Milk that has been cooled by water or ice should not be exposed to an atmosphere ten or twenty degrees warmer, for it then becomes a facile condenser and absorbent. While the air is seldom pure enough not to injure milk that is ten degrees colder, it is seldom so impure as to vitiate milk that is ten degrees warmer. It is of course expedient to remove milk at once from the odours of the cow-house to the comparatively pure air of the milk-room, yet there is no special need to do so to avoid contamination, so long as the air is colder than the milk. Yet the odours of the cow-

house are often traceable in the milk, and it is thought they get into it by absorption ; this may be so, and will be so when the air is warmer than the milk. It is a good thing to have cow-houses well ventilated, and kept as clean as possible."<sup>1</sup>

In the process of milking it should be borne in mind that the milk first drawn from a cow is always thinner, and inferior in quality, to that afterwards obtained, the richness of which increases progressively.

It should also be recollected in the after process, that the portion of cream rising first to the surface is richer in point of quality, and greater in quantity, than that which is yielded in the second equal space of time, and so of the rest ; the cream continually decreasing, and becoming thinner and poorer. This is due to the larger globules rising first, the smaller remaining in the milk. If thick milk is diluted with water, it will afford more cream than it would have yielded in its pure state, though its quality will be inferior.

Milk carried about in pails, or other vessels, and thus agitated and partially cooled before it is poured into the milk-pans, never throws up such good and plentiful cream as if it had been put into proper vessels immediately after it came from the cow.

From these fundamental facts several important inferences, some of which have already been hinted at, as serving to direct the proceedings of the dairy, may be deduced.

1. It is evidently of much importance that the cows should be milked as near to the dairy as possible, in order to prevent the necessity of carrying and cooling the milk before it is put into the dishes ; and as cows are much hurt by far driving, it must be a great advantage on a dairy-farm, where the practice of house-feeding is not adopted, to have the principal grass fields as near the dairy homesteads as possible.

2. The practice of putting the milk of all the cows of a large dairy into one vessel, as it is milked, there to remain until the whole milking is finished, before any part is put into the milk-pans, is highly injudicious, not only on account of the loss sustained by the agitation and cooling, but also because it prevents the owner of the dairy from distinguishing the good milk from the poor, and guiding him with respect to the profit that he derives from each cow. A better practice, therefore, is to have the milk drawn from each cow put separately, or to have that from only two or three cows put into the creaming-pans as soon as milked, without being mixed with any other.

A small quantity of clear water, cold in summer, and warm in winter, put into the bottom of a milk-pan, will facilitate the rising of the cream ; some persons put in a very weak solution of carbonate of soda.

3. If it is intended occasionally, or generally, to make butter of an *extra fine quality*, the milk of all the cows that yield cream of a poor or inferior quality should be rejected, and also the milk that is first drawn from each cow.

<sup>1</sup> "The Farm and the Dairy," Sheldon, pp. 61, 62.

Whenever the making of cheese and of butter of the highest and purest quality is aimed at—and surely this should be the case with every dairyman and with the manager of every factory—it is of the first importance to have the milk absolutely free from all impurities. It has long been known that there is scarcely any substance with which we have to deal which is so liable to be tainted as milk. Hitherto it has been considered that all that was necessary to prevent this tainting was to secure the most perfect cleanliness in everything used in connection with milk, to see to the condition of the cow-houses, their distance from places where bad odours arise, the cleanliness and thorough ventilation of the milk-room, the cleanliness, sweetness, and purity of the vessels used for keeping the milk, of the churns and the cheese-vats. But despite the closest attention to all these points—and they are of such vital importance that attention to them cannot be too much insisted on—recent experience has shown that there are other causes of tainting, which are even perhaps more dangerous in their effects than those named. Such extra taints, if so they may be named, no doubt have been noticed so far as their defects are concerned, but their causes remained unknown; and it is curious to note that these causes have been brought into prominence in consequence of the introduction of new methods of using milk on a large scale, prominent amongst which stands the process for making “Condensed or Preserved Milk,” a trade now of great commercial importance. The same gentleman who reported in the Royal Agricultural Society’s Journal on the American butter-factories (vol. vii., second series, 1871)—Mr. X. A. Willard of the Cornell University, and of the Maine Agricultural College—in a subsequent report (vol. viii., 1872), on the American milk condensing factories, goes somewhat fully into the tainting of milk.

Mr. Willard points out the general results of the investigations of the learned Hallier and Pasteur, who by means of microscopic observations of the most elaborate character were enabled to show the nature of those causes which are in operation, which change milk from its normal condition, or which render it filthy and unwholesome. These investigations, as may be known to many of our readers, were made in connection with the “germ” theory of disease, with which perhaps more markedly or popularly the name of Pasteur is associated.

From the instant the milk leaves the cow micro-organisms begin their work, and increase with marvellous rapidity. But a very great difference between the condition in which these fungi appear and do their work in milk and in its after products must be here noticed, as it bears closely upon the very point we have now under consideration, namely the tainting of those products. Thus if the spores of the fungi are already in pure milk, to begin with, or are added to the rennet if cheese be made, the fungi appear to do no harm, but in the case of cheese, at all events, seem rather to act in a legitimate way, if it may be so termed; as giving or imparting the peculiar flavour by which the cheese is distinguished. But if the spores come from putrid matter,

and gain access to the milk in cheese, they exercise a highly prejudicial influence. Such organisms find in the milk a substance precisely fitted to aid them in farther and rapid development; which accounts for the amazing readiness with which milk becomes tainted, and the quickness with which decomposition goes on when once it has begun.

We have already adverted to the importance of keeping the bodies of the cows thoroughly clean by currycombing, or by wisping them down with straw; but this was chiefly in view of the advantage of aiding the functions of the skin—a matter of great importance, which cannot be neglected with impunity. But a new view has arisen since these germ investigations have been made; for it appears that dirty matter adhering to the skin, and lodging between the folds of the udder, &c., and becoming dry, falls into the milk-pail during the process of milking, and by thus introducing the germs into the milk causes decomposition therein. Not only, therefore, should cows be carefully kept “body clean,” by currycombing, so that all adhering matter may be taken off them, but the practice so often permitted of allowing the animals to pass through or stand in mud at gates, edges of water ponds, &c., should not be allowed. This mud is almost invariably mixed with ordure, and the liquid exuvæ of the animals, and, being allowed to remain for perhaps months, becomes tainted in the highest degree. From this will be seen the importance, therefore, not only of having the interior of the cow-byres sweet, and the animals themselves and all the vessels thoroughly clean, but also all the “surroundings” of the dairy,—roads, ponds, &c. The same remark applies to the courts into which the cows are turned for fresh air, when housed for the winter or when kept on the summer soiling system. The dirty practice of wetting the hands with milk in the process of milking should be discouraged.

The taints and flavours of milk and milk-products, and the ripening of the latter, have been shown by recent investigation to be closely allied phenomena. Professor A. Harker, in writing on the subject in the “Journal of the British Dairy Farmers’ Association” (1889), remarks that, though till recently regarded as solely a question of chemistry, it is now known that the action of certain living organisms, chiefly minute plants, precedes and is the cause of the elaboration of most of the delicate, and often fugitive compounds, which together make up the so-called flavour of all dairy products. There is no natural product so delicate, so susceptible to minute deteriorating influences, so readily affected by physical changes in itself or its surroundings, so variable from causes apparently beyond our reach, as the material of the dairy farmer—Milk. Of the principal dairy products, cream, condensed milk, butter and cheese, the two latter are of chief importance in a study of flavours, though it is cheese which presents the greatest difficulty and variation in its maturing or “ripening.” In even perfectly made butter the action of micro-organisms supervenes after a time and prevents its keeping for long, whilst in badly made butter the action of these organisms is favoured almost as if intentionally, and the unfavourable results are more rapid and pronounced. The action of

minute forms of plant life on even the best of butter leads to the liberation of the volatile acids, and produces rancidity, and in the case of the carelessly and imperfectly made article, only partially washed and drained, the sugar and casein left in the butter do but hasten the changes.

The changes which take place in milk are now known to be largely due to the growth within and upon it of specific organisms which have the faculty of multiplying with amazing rapidity. They affect the milk by their living actions, extracting from it those constituents necessary to the building up of their own bodies, and leaving the remaining constituents, which they do not require for that purpose, arranged in new and varied combinations. The organisms are undoubtedly of many different kinds, and unlike each other in their effects upon the milk. From the time the milk is drawn from the udder till the time when coagulation is effected there may be established (by migration from the air or from any source in contact) healthily multiplying colonies of, it may be, some score of different organisms. The primary cause of variability in the product is the presence in the curd and whey of a crowd of living organisms which have been affecting the milk from the first, and are to continue to act upon it after its conversion into curd, and the subsequent matting, draining, pressing, and drying of the cheese. There are two fairly distinct classes of living things which affect the curd and whey of cheese, many of them not found in the milk at all, but the results of an after colonization in the curd itself, either during its crumbling or even after it has been formed in the vat. These two classes are the bacteria on the one hand and the true fungi on the other, and it may be taken generally that the bacteria are present in the milk and curd from the first, and that the fungi come later on, after the former have partially completed their life. Both, however, assist, often simultaneously, in the change of curd into cheese, and subsequently give rise to the flavours which characterize the product.

There is still another pregnant source of evil in connection with the germs which infest the milk and so much deteriorate it. This is the water supply. Now, as a rule on farms, the proper degree of attention is not paid to this; anything, almost, in the form of water being thought good enough for the stock to drink. On this point the reader will find some remarks in another chapter of this work. Here it is sufficient to say that stagnant water, impure water—even although it be not stagnant but running water,—well water, all of which contain in many instances decaying or decayed organic matters, may, when taken into the system, give rise to products which will greatly injure the quality of the milk.

There has been much speculation as to whether the milk from tuberculous cows can be consumed with impunity; and, having regard to the fact that milk is so frequently employed as food without cooking, more especially for children, there appears to be considerable risk attending its use. Professor Duguid, discussing this subject in "The Journal of the Royal Agricultural Society, 1890," says (page 314) that tuberculous milk must be looked upon as dangerous and likely to be the means of

producing the disease (tuberculosis or consumption) in young or weakly subjects consuming it. The chief difficulty in determining whether the milk of any particular cow or cows is dangerous lies in the inability of the veterinary surgeon to say whether there are any tubercular deposits in the udder. Milk may contain these organisms and even a skilled bacteriologist fail to find them; their absence in the few drops which he examines is no guarantee that they may not exist. Recent experiments in the United States have demonstrated that where tuberculous cows showed no signs of the disease in the udder their milk nevertheless proved infective to rabbits and guinea-pigs fed with it. The results of feeding experiments all tend to prove that the milk from tuberculous cows, if given to animals in the uncooked state, possesses a very much higher infective power than the flesh.

*Butter.*—Milk consists mainly of three component parts, the *butyraceous*, or oily or fatty substance of which butter is composed; *caseous* matter, from which cheese is formed; and the *serum*, or whey. The comparative value of different dairies, and of different cows in each dairy, depends not only on the quantity of milk itself, but also on the quantity of butter or casein it contains. The ingredients named differ materially in specific gravity or weight, and to separate them is the chief object of the dairy. The cream is the lightest, next in specific gravity is the whey, and the curd is the heaviest. The manufacture of butter involves the separation of the butyraceous part, and this is a mere question of gravity. The milk is left undisturbed, and thus the lighter portion mechanically quits the heavier one, and floats on the top. The separation of the curd from the serum—in the manufacture of cheese—involves coagulation followed by precipitation.

The cream, having separated from the other component parts of the milk in about twenty or two-and-twenty hours, in a medium temperature, is carefully skimmed off, and poured into a vessel, until enough is obtained for churning; or the milk alone is let off by taking out a plug in the bottom of the pan. When the cream has been thus collected, it should be placed in a deep, covered vessel, for the action of the air on the surface dries it. It should also be stirred with a stick or spoon, every time a fresh quantity is added. The object of this is to ensure uniformity as to ripening. The time of keeping it depends on the weather. If the cream from each milking has been kept separate, it may remain from two to four days, in warm weather, without being injured; but if sweet cream is mixed with that which is sour, the two ferment and soon become clotted if the churning is delayed beyond three days. This may be in some degree prevented by the stirring; but it is generally considered best to keep separate the cream from each milking, and thus allow each to become ripe of itself. Cream should be churned before it becomes sour, or the delicate flavour of the butter will be injured. When it is on the point of turning a little sour, it is considered "ripe," and then is the time to churn it. The "ripeness" can be tested with litmus paper. Butter from ripened cream has a flavour more matured than that from sweet cream, and the ripened cream churns all the easier.

In some counties the separation of the cream from the milk is not thought to be sufficiently complete by this mechanical process, but, after the milk has stood from twelve to twenty-four hours in the pan, it is put over a slow fire, where it remains until it begins to *simmer*, or is about to boil. As soon as the first bubble raises the surface of the cream, the pan is taken off the fire, and put carefully away for eighteen or four-and-twenty hours, in order to cool. At the end of this time, if the quantity of milk is considerable, the cream will be an inch or more in thickness upon the surface. It is then divided with a knife into squares of a convenient size, removed by means of a skimmer, and called *clotted* or *clouted* cream. It is more solid than the cream obtained in the usual way, and has a peculiarly sweet and pleasant taste. The milk thus treated yields one-fourth more cream than is produced in the common way, but this is at the expense of the residue. It more readily churns than cream produced in the usual way, and forms a butter retaining the peculiar taste of the *clouted* cream.

The cream obtained by the ordinary process of setting consists of the butyraceous portion of the milk with some quantity of casein and of the serous fluid, and these must be separated from each other. This has been found to be best effected by agitation. It might be contrived, on a small scale, by means of a bottle, but it is better accomplished by the help of a *churn*. The cream is violently agitated, and the churner works patiently on until some small particles of butter begin to appear, or, in the language of the dairy, the butter *begins to come*.

There is considerable art connected with this apparently simple manipulation. The churning must not be too rapid or violent, nor must it be too slow and gentle. In the first case, and especially in summer, the product would ferment and become ill-tasted; in the latter it would hardly form at all. From forty to forty-five revolutions per minute is about the proper rate of speed in the case of a barrel churn, and this speed should be reduced at both ends of the process of churning. With an "end over end" churn, sixty revolutions per minute are suitable. The temperature should be carefully regarded. In summer it may be 56° F., and in winter 60° to 62°. In summer the churn should be prepared by moistening the inside with cold water; in winter, with warm water. In summer the churning should be done in a cold room; in winter in one whose temperature is about 60°. Miss E. A. Maidment, in her pamphlet, "The Butter Dairy and its Management," says the following table may be safely adopted:—

Temperature of Air (Fahr.).	Temperature of Cream (Fahr.).
66°	55°
64°	56°
62°	57°
60°	58°
58°	59°
55°	60°
50°	61°

All churns should have a valve or a plug through which the evolved



gas may be repeatedly allowed to escape; and a small pane of glass, through which, without opening the churn, the state of the cream may be noticed from time to time as the churning proceeds, is also to be recommended.

When the butter begins to form it is seen in small granules, and the pane of glass is no longer clouded but comparatively clear. When the granules have aggregated to the size of mustard-seed, the churn should be brought to rest. This, indeed, is the only stage at which the butter may be thoroughly separated, by washing, from the caseous matter held suspended in the butter-milk. Nearly all the butter-milk should then be let out of the churn through a sieve, clear, cold water should be put in, the churn should be turned a time or two, the water should be let out through the sieve, and the process should be repeated until the water comes out nearly as clear as it went in, by which time the butter will be thoroughly washed. Care, indeed, must be taken not to over-wash it, and so diminish its quantity and make it insipid. The butter may then be taken out in a mass, of clear, golden colour, and in a granular state; and it may be put at once on the butter-worker, in order that the superfluous moisture may be pressed out of it, and the salt worked in. The triple use of a butter-worker, in fact, is to press out the water, press in the salt, and consolidate the butter into a solid, compact mass, without injuring the grain or making the butter greasy. The proportion of salt worked in will vary from one to five per cent.; but when the butter has been perfectly washed, in the manner described, it will keep sweet some time, in a suitable temperature, without any salt at all. Yet is it true that a little salt will improve the taste of butter, as it will that of fresh beef or mutton.

The best authorities consider that butter should not be touched by hand, and indeed few hands are cold enough not to injure the butter more or less. A butter-worker is represented in figs. 64 and 65, page 269.

The following simple rules for butter making are published by the Royal Agricultural Society of England, 13, Hanover Square, London, W.—Prepare churn, butter worker, wooden hands, and sieve as follows:—

- |                                |                                |
|--------------------------------|--------------------------------|
| (1.) Rinse with cold water.    | (3.) Rub thoroughly with salt. |
| (2.) Scald with boiling water. | (4.) Rinse with cold water.    |

*Always use a correct thermometer.*

The cream, when in the churn, to be at a *temperature* of 56° to 58° F. in summer, and 60° to 62° F. in winter.

The churn should never be more than half full.

Churn at number of revolutions suggested by maker of churn. If none are given, *churn at 40 to 45 revolutions per minute*. Always churn slowly at first.

*Ventilate* the churn *freely* and frequently during churning, until no air rushes out when the vent is opened.

*Stop churning immediately* the butter comes. This can be ascertained by the sound; if in doubt, *look*.

The butter should now be like grains of mustard seed. Pour in a small quantity of cold water (one pint of water to two quarts of cream) to harden the grains, and give a few more turns to the churn gently.

Draw off the butter-milk, giving plenty of time for draining. Use a straining cloth placed over a hair sieve, so as to prevent any loss, and wash the butter in the churn with plenty of cold water; *then* draw off the water, and repeat the process until the water comes off quite clear.

Make a strong brine (2 to 3 lb. of salt to 1 gallon of water) and pour into the churn through a hair sieve. Rock the churn a few times before drawing off the brine; take the butter out of the churn, put it on the butter worker, and leave it for a few minutes to drain; then work *gently* until all moisture is pressed out.

N.B.—*Never touch the butter with your hands.*

Miss Maidment observes that salting with brine is recommended for ordinary fresh butter as reducing the amount of working necessary to complete the process. "It is dependent for its success on the strength of the brine, the size of the granules of butter, and the length of time they are exposed to its action. The saltiness of a butter must be regulated to meet the market in which it finds its customers, but a brine made in the proportion of half a pound of salt to one quart of water will usually, with half an hour's exposure, give saltiness enough for ordinary customers. The London trade demands an almost saltless butter, for which four minutes' brining will serve. The quantity of brine made must be sufficient to cover the butter. If by over-churning (though this should not occur) the butter has collected into granules of too large a size, brining is rendered useless, and dry salting must be followed, with  $\frac{1}{8}$  to  $\frac{1}{4}$  oz. per lb., according to market."

Dr. Anderson recommends the following preparation as not only preventing the butter from becoming tainted and rancid, but also as improving its colour, while it imparts a sweeter or richer taste than could have been effected by the use of common salt only:—

"Let two parts of the best common salt, and of sugar and saltpetre each one part, be completely blended together by beating, and add one ounce of this mixture to every pound of butter. Incorporate it thoroughly in the mass, and close it up for use.

"It will be necessary to keep butter, thus prepared, for two or three weeks before it is used, otherwise it will not taste well; but, if properly cured, according to the above prescription, it will continue so perfectly sweet for three years or more, as not to be distinguished from newly-made salted butter." It is said that in Holland the salt for butter that is intended to be kept is mixed with the milk before it is churned, by which means both its flavour and preservative qualities are more effectually imparted.

Before the butter is put into the firkin it should be made as dry as

possible. A thin layer of salt should then be strewed on the bottom of the cask, and each successive layer of the butter thoroughly moulded into that beneath it. When the cask is full, more salt should be strewed over it, and the head put on. If the butter has been previously well freed from the milk, and the salt moulded into it quite dry, it will not shrink in the cask. This is always regarded as one criterion of the goodness of the butter.

The best butter is that which is made during the season of fresh grass; but, with the addition of a certain portion (which experience only can determine) of the juice expressed from the pulp of carrots, or some ground annatto-root (*Bixa Orellana*), to the cream previously to churning, winter-made butter will acquire the appearance, though not the flavour, of that which has been churned during the prime part of the summer season.

Upon the subject of colouring, Miss Maidment says, "If this *must* be practised, aim at a natural colour and uniformity. The best standard is the natural summer tint, and to maintain this, when the butter would be otherwise pale, add such colour as will make good the deficiency. The best preparation known to the writer is Nicholls's Annatto, of which one drachm will colour from two to eight gallons of cream, according to need. Whatever is used should be carefully estimated and measured in a glass measure (one of two ounces divided in drachms, and costing 9*d.*) and diluted with water (a pint is sufficient), the water to rinse the measure added, and the whole thoroughly mixed with the cream."

The process of making butter by churning *milk and cream together*, which was formerly much practised in Holland, is usually as follows:—The milk is put into deep jars in a cool place, each *meal* or portion milked at one time being kept separate. As soon as there is the least appearance of acidity, the whole is placed in an upright churn. When the butter begins to form in small kernels, the contents of the churn are emptied on a sieve that lets the butter-milk pass through. The butter is then formed into a mass, as before described.

In Ireland the process still is similar in some parts of the country, but the milk is allowed to arrive at a greater degree of acidity. This is a defect.

The practice of making butter from *lapped* (*i.e.*, coagulated) milk is followed in Scotland. The milk is placed in a large barrel and left for from two to three days till a sufficient degree of acidity is attained, and then the *whole* milk is churned. Butter thus made has been very successful in the butter classes at Scottish agricultural shows.

Of the average quantity of butter produced from one cow, or from a dairy of cows, it is impossible to give any accurate estimate. It would vary with the breed, the pasture, and the management. From  $2\frac{1}{2}$  to  $3\frac{1}{2}$  gallons—10 to 14 quarts—will generally produce about a pound of butter, and a good cow, in order that dairy husbandry may remunerate the farmer, should yield 200 lb. at the least, in the course of the year, this being produced from 600 gallons of milk. A cow, including pasture and hay, can scarcely be fully provided for from less than three

acres of tolerably good land, the rent of which, with the taxes, costs, casualties, servants' wages and food, will hardly leave more than a moderate remuneration to the farmer. The reader may be referred, for special information on the subject to Professor Sheldon's work, "The Farm and the Dairy," published by Messrs. G. Bell and Sons.

Some valuable facts concerning yields of butter which have been accumulated through the efforts of the English Jersey Cattle Society (established 1878), may at this stage be noticed. The exhibition of this Society, held on the 15th and 16th of May, 1890, at Kempton Park, Sunbury-on-Thames, is believed to have been the first show in England devoted exclusively to any individual breed of cattle.

The Prize List was drawn up with a view to show—

That the Jersey breed of cattle is well adapted for producing the largest quantity and finest quality of butter.

That when judiciously reared it comes early to maturity, is naturally a small consumer, and will be found most profitable for the dairy.

That English bred animals may be favourably compared with those bred on the Island, where the climate is more genial.

Instead of first, second, and third prizes, three equal premiums of 10*l.* each were given in each class, and in the butter test classes the Society's gold, silver, and bronze medals were awarded in addition to the premiums.

The list of awards contained, in addition to the usual information, the age, live weight, date of birth of last calf, and weight of milk of each animal.

The figures shown by the weighing machine were most instructive and often surprising. As an instance may be noticed the case of a beautiful cow, "Carillon," whose yield of milk in eighteen days would equal her live weight.

Mr. John Frederick Hall, of Sharcombe, Wells, Somersetshire, reported as follows on the butter test:—

The cows competing for the Society's premiums in connection with the butter test arrived in the show ground on Monday, May 12th, and were divided into two classes, viz.:—

Class 11, for cows having had not less than three calves (21 cows).

Class 12, for cows not having had more than two calves (7 cows).

All these cows were milked dry between 6 and 7 o'clock on the Monday evening. Tuesday's milk was drawn and weighed at 8:30 A.M. and 6:30 P.M., and after being raised to a temperature of 80° F., was passed the same evening through Laval's hand-power separator.

Two of these machines completed the process of separation in three hours' working. About a gill of buttermilk was then added to each lot of cream as a "ferment starter."

On Wednesday morning the cream was raised to a uniform temperature of 58°, and at 11 A.M. four churns were put in motion. By 5 o'clock the churning of the twenty-eight samples was finished, and the unsalted butter weighed.

The table of results is shown on page 311, and the table of foods is given on page 312.

BUTTER TEST AT KEMPTON PARK, MAY 15, 1890.—CLASS 11: JERSEY COWS HAVING HAD NOT LESS THAN THREE CALVES.

Catalogue No.	Name of Cow.	Exhibitor.	Date of Birth.	Live weight.		Date of last calf.	Days in milk.		Milk yield.		Butter.	Butter ratio, viz., lb. milk to 1 lb. butter.	Awards.
				lb.	oz.		lb.	oz.	lb.	oz.			
229	Sherry	Dr. H. Watney	Mar. 5, 1883			Dec. 8, 1889	156	41	1	2	83	16.12	Gold medal and £10 Silver medal and £10 Bronze medal and £10
230	Tiny 3rd	S. H. Williams	Mar. 3, 1886	879		April 26, 1890	17	85	11	2	72	14.45	
218	Bitberry	S. Baxendale	Oct. 27, 1883	1086		Jan. 19, 1890	114	33	12	2	43	14.89	
217	Meadow Pride	W. Adams	July 4, 1884			April 24, 1890	19	35	6	2	03	17.28	
219	Frieda.	E. Carter.	April 28, 1880	833		Mar. 10, 1890	64	19	6	1	12	10.87	
220	Stella	E. Carter.	Dec. 15, 1883	890		Mar. 11, 1890	63	31	7	2	04	15.59	
222	La Presse	Mrs. Crookes	May 27, 1882	803		Feb. 22, 1890	80	24	4	1	62	17.24	
223	Mazzini's Pride	Mrs. Crookes	June 12, 1883	899		Mar. 15, 1890	59	32	4	1	11	8.76	
224	Example 2nd	The Ladies Hope	Feb. 22, 1884	1018		Oct. 11, 1889	214	29	12	1	13	16.41	
225	Sweet Marjorie.	John B. Lloyd	Dec. 12, 1883	865		Feb. 22, 1890	80	23	0	1	15	11.68	
226	Sunflower	Hugh C. Smith	July 26, 1880	941		June 4, 1889		28	0	1	11	16.14	
227	Melissa 2nd	John Swan	April 1, 1886	747		April 4, 1890	39	30	9	1	14	16.03	
228	Flora	Dr. H. Watney	Mar. 3, 1882	886		April 9, 1890	34	31	5	2	1	15.18	
234	Young Doctress	J. Brutton	June 25, 1883	986		Dec. 7, 1889	157	22	8	1	10	13.58	
235	Maudie	J. Brutton	July 27, 1883	1028		Mar. 30, 1890	44	35	6	1	12	20.21	
236	M. T. No. 2	J. Brutton	Dec. 1880	998		Dec. 17, 1889	147	19	11	1	9	12.60	
237	Disgusted 3rd	A. C. P. Gurney	April 26, 1885	857		Feb. 27, 1890	75	35	9	1	5	26.46	
239	Maple	C. and M. Palmer.	Feb. 8, 1883	828		April 10, 1890	33	30	1	2	1	14.57	
240	Belle Broughton 3rd.	G. W. Palmer	Nov. 6, 1884	888		Feb. 12, 1890	90	20	4	1	84	13.36	
241	Mayflower	G. W. Palmer	Jan. 16, 1886	801		Jan. 8, 1890	125	19	4	1	51	14.32	
242	Wolsley's Fancy	G. W. Palmer	June 15, 1884	808		April 30, 1890	13	33	0	1	10	19.92	

CLASS 12.—JERSEY COWS HAVING HAD NOT MORE THAN TWO CALVES.

247	Finish.	E. Carter.	Feb. 9, 1886	857		Jan. 3, 1890	130	33	6	1	15	17.22	Gold medal and £10 Silver medal and £10 Bronze medal and £10
244	Blossom 2nd	W. Adams	April 4, 1887	698		April 4, 1890	39	25	13	1	15	13.21	
254	Cynthia	Mrs. Perkins	Jan. 14, 1887	765		April 20, 1890	28	26	5	1	14	13.80	
249	Primrose Dame	J. B. Lloyd	Mar. 18, 1887	657		Feb. 13, 1890	89	23	12	1	4	18.53	
250	Gorse	S. Baxendale	Mar. 24, 1888	882		Mar. 16, 1890	58	23	4	1	13	12.82	
252	Do Good	C. and M. Palmer.	Mar. 28, 1887	672		Oct. 2, 1889	223	16	5	0	15	16.83	
253	Elmhurst Beauty.	G. W. Palmer.	April 2, 1888	699		April 9, 1890	34	24	8	1	10	15.07	

FOOD RETURN OF JERSEY COWS TESTED FOR BUTTER AT KEMPTON PARK SHOW, MAY, 1890.

*Extract from Conditions of Entry.*—

“A certificate declaring all the food used for a fortnight before and during the Show must be given to the Society.”

No. in Catalogue.	Exhibitor, and Particulars of Feeding.	FOODS USED.														
		Bibby cake.	Cotton cake.	Decorating cake.	Feeding cake.	Linsseed cake.	Crushed oats.	Crushed wheat.	Bean meal.	Linsseed meal.	Maize meal.	Germ sharps.	Bran.	Grains.	Mangel.	Par-snips.
217, 244	W. ADAMS. Cattle both grass and stall fed; 7 lb mixture in addition to other food.	lb. ..	wt. ½*	lb. 2	lb. 2	lb. ..	..	lb. ..	lb. 15*	lb. ..	1*	lb. ..	..	..	..	..
234, 235, 236	J. BRITTON. Cattle out day and night; mangel only given at show.	..	..	3	2	..	..	..	..	..	..	6	½	lb. 12 bush. 1½	..	..
219, 220, 247	E. CARTER. At grass, with hay and water.	..	..	4 to 5	2	..	..	..	..	..	..	2	..	..	..	..
222, 223	Mrs. CROOKES. Cows at pasture, heifers and bulls stall fed.	Cows 4 Heifers 2	..	..	..	..	..	..	Cows 4 Heifers 2	..	..	..	..	..	..	..
224	THE LADIES HOPE. Cow, stall fed, with a little grass.	..	..	..	4½	5	..	..	..	..	..	galls. 2	..	..	..	..
239, 252	C. AND M. PALMER. Cattle, at grass, hay twice daily, no artificial food given for 6 weeks.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
240, 241, 242, 253	G. W. PALMER. Cattle, stall fed until within the last fortnight.	..	..	..	..	3	..	..	..	..	3	3	..	lb. 10	..	..
226	HUGH C. SMITH. Cow grass fed.	..	..	..	2	peck 1	..	1	..	..	..	bush. ½	..	..	..	..
227	J. SWAN. Cow stall fed; silage, rye, and tares, 40 lb. per day; during show green food substituted.	..	..	..	..	..	3	3	..	..	..	..	..	..	..	..
228, 229	DR. H. WARNEY. Cows at grass; Thorley's food also used during show.	..	..	4 during show.	4	..	..	..	1 during show.	..	lb. 1½	2	..	½	1	..
218	S. BAKENDALE. Cow at grass.	..	0	3	..	7 galls. 2½	..	..	..	..	..	galls. 1½	..	..	..	..
254	Mrs. PERKINS. Heifer stall fed, 8 lb. hay, very little grass, and 2 lb. Thorley's cakes.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

\* For 14 days.

The butter generally was of good colour and quality, but in the case of two cows an excessive use of mangel had destroyed every trace of colour. As regards the quality of the milk, it affords remarkable testimony to the value of the Jersey cow for butter production. The average yield of the twenty-eight animals tested was one pound of butter from a trifle over six quarts of milk.

*The butter produce of Jersey Cows.*—From the time the English Jersey Cattle Society made its first experiment in butter testing at the Agricultural Hall, Islington, in October, 1886, up to 1897 inclusive, many tests had been made, at which 745 Jersey cows, varying in age from under two to over thirteen years, had been put to proof.

From a tabulated summary of the results of these tests it appears that the development of the butter capacity is very gradual, and it seems probable that even at the end of her fifth year the average Jersey cow has not attained her maximum point of butter production.

The milk yield, which, between the age of two and three years, reaches an average of 2½ gallons, or say 25 lb. per day, continues to increase till the ninth or the tenth year, when it stands at rather over 3½ gallons, or 35 lb. per day. At the same time, the butter shows a corresponding increase from 1 lb. 4 oz. to 1 lb. 14 oz. per day. During the whole of these eight years it appears that the average richness of the milk varies but little from a standard of two gallons to the one pound of butter. The average results from the 745 Jersey cows above mentioned are:—

One day's milk . . . .	32 lb. 6¼ oz., equal to 3 gallons a day.
One day's butter . . . .	1 lb. 11¼ oz.
Butter ratio . . . . .	19'02, about 16 pints milk to 1 lb. butter.
Average days in milk, 70.	

*At or about the age of six years the Jersey appears to attain her prime.*—Her milk increases materially in richness, and her yield of butter shows a proportionate advance. It seems probable that she maintains this maximum value for some two or three years afterwards:—

Between 6 and 7 years, average butter ratio,	19'14 lb.
„ 7 and 8 years „ „	18'66 lb.
„ 8 and 9 years „ „	19'12 lb.

This view of the prime age of the butter cow derives further confirmation from a comparison of the ages of those cows which succeeded best throughout the series of ten tests that had been completed up to May, 1890. These are as follows:—

	Years.	Months.	Days.
Average age of 10 first prize cows . . . .	7	3	10
„ „ 10 second prize cows . . . .	6	2	0
„ „ 10 third prize cows . . . .	5	8	2
„ „ 10 reserve number cows . . . .	5	5	8

The total number of cows of nine years and upwards is too small to afford a basis for judgment, but it is sufficient to warrant the statement that some Jerseys maintain a high dairy value in their tenth year, or even beyond. The summary table on the next page, extending over twelve years, shows this.

The following cows gave the maximum yields of butter from one day's milk in their respective classes:—

				lb. oz.	
Cows between	2 and 3 years	Mrs. A. P. Norris' Stella	.	1	15
"	"	3 and 4 years	Mr. Simpson's Pandora 11th	.	2 0 $\frac{1}{2}$
"	"	4 and 5 years	Rev. H. S. Williams' Tiny 3rd	.	2 7 $\frac{1}{2}$
"	"	5 and 6 years	Mr. Adams' Meadow Pride	.	2 0 $\frac{3}{4}$
"	"	6 and 7 years	Mr. Brutton's Baron's Progress	.	3 5
"	"	7 and 8 years	Dr. Watney's Sherry	.	2 8 $\frac{1}{4}$
"	"	8 and 9 years	Mr. Carter's Coquette	.	2 4
"	"	9 and 10 years	Mr. Baxendale's Bramble	.	1 14 $\frac{1}{2}$
"	"	10 and 11 years	Mr. Baxendale's Broom	.	2 4 $\frac{1}{2}$
"	"	12 and 13 years	Mr. H. C. Smith's Lady Savage	.	2 0 $\frac{1}{4}$

The subjoined table presents a summary of the English Jersey Cattle Society's butter tests from 1886 to 1897 inclusive.

Cows' Ages.	No. tested.	Average days in milk.	Average milk yield.		Average butter yield.		Average butter ratio.	
			lb.	oz.	lb.	oz.	lb. milk to 1 lb. butter.	
Over 1 and under 2 years . . . . .	2	34	15	2	0	13		18·43
" 2 " 3 " . . . . .	43	59	24	15 $\frac{1}{2}$	1	4 $\frac{1}{2}$		19·48
" 3 " 4 " . . . . .	87	69	30	4	1	9 $\frac{1}{2}$		18·87
" 4 " 5 " . . . . .	124	68	31	15 $\frac{1}{4}$	1	10 $\frac{3}{4}$		19·09
" 5 " 6 " . . . . .	134	72	32	9 $\frac{1}{4}$	1	11 $\frac{1}{2}$		18·93
" 6 " 7 " . . . . .	129	85	33	12 $\frac{1}{2}$	1	12 $\frac{1}{2}$		19·14
" 7 " 8 " . . . . .	96	79	33	6 $\frac{1}{2}$	1	12 $\frac{1}{2}$		18·66
" 8 " 9 " . . . . .	51	72	33	2 $\frac{3}{4}$	1	11 $\frac{3}{4}$		19·12
" 9 " 10 " . . . . .	31	81	34	0 $\frac{3}{4}$	1	13		18·77
" 10 " 11 " . . . . .	27	84	35	10 $\frac{1}{2}$	1	14 $\frac{1}{2}$		18·66
" 11 " 12 " . . . . .	10	82	38	11 $\frac{1}{2}$	1	14 $\frac{1}{4}$		20·46
" 12 " 13 " . . . . .	8	73	35	3 $\frac{1}{4}$	1	11 $\frac{1}{4}$		20·72
" 13 " 14 " . . . . .	3	54	42	1 $\frac{1}{4}$	2	1 $\frac{1}{2}$		19·85

Butter is the culmination of the dairyman's art. This great delicacy consists of the natural fats of milk, with some water, and should contain nothing else, except as we choose to flavour it with salt. The perfection of butter-making is to secure these fats, separated from the serum or fluid of the milk, and gathered in a mass, with as little chemical and physical change as possible. Unfortunately, perfection has not yet been reached in this art, and there is always present in butter, mingled with the fats and to some extent dissolved in the water, more or less of the protein or curd, and of the sugar of milk. It is these ingredients which play the mischief with butter, by starting the chemical changes leading to rancidity and decomposition. Whilst, therefore, in nearly all other food-products the presence of protein (because of its high nutritive quality) adds to the value of the article, in the case of butter—if it be placed at all in the list of foods—that which has the highest nutrient value is the poorest in those qualities which go to make fine butter. We buy butter for its fat, and the more fat and the less water and protein, the better it is as butter.

The presence of water in butter is associated with the hardness of the latter. On this point, Mr. F. J. Lloyd says ("Journal of the Bath and West of England Society," 1890—91, page 119), "Hardness depends mainly on the amount of water left in the butter; this may



vary from 9 to 19 per cent. Water being liquid at all ordinary temperatures, the more there is present the softer the butter; in the summer too much is generally left in, which makes the butter soft, while in the winter butter frequently contains far less water, and is too hard. The finer the granules are when brought in the churn, the more water will the butter retain, and no amount of subsequent work on the butter-worker will get rid of it. In summer, therefore, it is necessary to collect the butter into larger granules than in winter, so as to exclude water. And before working it is essential to place the granular butter in a cooling box, not merely to lower the temperature and hence harden the granules, but mainly to allow the excess of water to drain away. In the winter smaller granules and more water are advisable."

The substance, remarks Duclaux, which is taken out of the churn is not pure butter fat, but consists of this material mixed with a little of the serum or whey, small quantities of casein, and milk sugar, as well as phosphate of lime and other mineral salts. In addition, there is water, the quantity of which depends upon the method which has been employed. M. Chevreul's investigations have shown that, in the fresh state, pure butter fat consists only of glycerides, that is, of compounds of glycerin with acids, the latter called fatty acids because they enter into the composition of fats. Some, as stearic, margaric, and oleic acids, have the appearance of fat, whilst others are liquids which dissolve in water. The fatty acids with a fat-like appearance were the first known, because they are relatively easy to isolate and are insoluble in water. Although all kinds of butter, notwithstanding differences in breeds and foods of cattle, contain approximately the same proportions of the same glycerides, yet there are, within very restricted limits, marked variations. The glycerides which have been found in butter are palmitin, olein, stearin, margarin (probably a mixture of palmitin and stearin), caprylin, caprin, caproin, and butyrim. The principal ones are present in about the following percentages:—

Stearin and palmitin . . . . .	62·8
Olein . . . . .	27·8
Caprylin and caproin . . . . .	6·0
Butyrim . . . . .	3·4
	100·0

Left to itself fresh butter gradually loses its fine and delicate flavour and becomes rancid. What happens chemically is this. In rancid butter, there appears in the free state several strong-smelling acids, one of which, butyric acid, has received its name because its odour is precisely that of rancid butter. Another, caproic acid, is named in reference to the fact that its odour calls to mind that of the goat (Lat. *capra*, a goat). The least traces of these acids in the free state powerfully affect both the flavour and the odour of butter, and it is primarily to their presence that butter owes those unpleasant qualities which are conveyed in the description *rancid*. The circum-

stances that lead to the development of the acids named are discussed at length by Duclaux, but the subject is too technical to be further followed here. The following results of analyses are recorded by the French investigator:—

PERCENTAGE COMPOSITION OF SAMPLES OF (ISIGNY) BUTTER.

Water . . .	12·40	. . .	13·36	. . .	12·28
Fat . . .	86·71	. . .	85·48	. . .	86·78
Milk sugar . . .	0·16	. . .	0·20	. . .	0·17
Casein and salts . . .	0·73	. . .	0·96	. . .	0·79
	<hr/>		<hr/>		<hr/>
	100·00		100·00		100·00

FAT.

Butyrin . . .	5·90	. . .	5·87	. . .	5·88
Caproin . . .	3·32	. . .	3·40	. . .	3·39
Other glycerides . . .	90·78	. . .	90·73	. . .	90·73
	<hr/>		<hr/>		<hr/>
	100·00		100·00		100·00
Free butyric acid } (per 1000 parts) }	0·093	. . .	0·106	. . .	0·114

An explanation of the significance of the “iodine number” and of the “viscosity number,” as recorded in the table on page 318, is given in the footnote.<sup>1</sup> The table is of interest, as showing that, when

<sup>1</sup> Butter, like other natural fats, is a compound of glycerin with palmitic, oleic, stearic, and other acids. When butter, or other natural fat, is boiled with alkali (potash or soda), the fatty acids and the glycerin are separated from each other, the acids combine with the alkali, forming with it a soap (hence the process is termed saponification), and the glycerin is set free. Soaps thus formed from the fat of milk (butter) may be termed “butter soaps,” and it is obvious that such soaps may be produced by the action of either potash or soda. Now, aqueous solutions, containing four or five per cent. of potash soaps, become, when rendered slightly alkaline by the addition of caustic potash, quite viscous, and, when the amount of free alkali (caustic potash) is considerable, are completely gelatinised. Each of the fatty acids, stearic, oleic, &c., which enter into the composition of fats and oils, forms with potash a soap whose aqueous solution has a definite degree of viscosity, which may be denoted by a number termed the coefficient of viscosity, or the viscosity number; consequently, the determination of the viscosity of soap solutions furnishes a means of discriminating between different fats and oils, and this is especially true in the case of butter and its substances. A soap made from fifteen grams of stearic or oleic acid, with ten grams of caustic potash, dissolved in water, and diluted up to half a litre (0·88 pint) will form, at a temperature of 68°, a very viscous solution—almost a jelly. Lard, tallow, cotton-seed oil, or olive oil, and all common fats and oils behave similarly, and the same is true of butterine, oleomargarine, and all the commercial substitutes for butter. On the contrary, butter itself when treated in this way gives a limpid solution, the viscosity of which is very slight; but, on account of the variations in the amount of their volatile acids and olein, butters have nevertheless a very wide range, so that small quantities of foreign fats mixed with butter may escape detection. The *volatile* fatty acids of butter (butyric, capric, caproic, and caprylic, but chiefly butyric) tend to reduce the viscosity of its soap solutions, partly on account of their low coefficient of viscosity, and partly on account of their high neutralising power, which leaves less alkali in solution. The determination of the viscosity number is practically effected on the same principle as that of the Nessler test for determining nitrogen in potable waters, namely, a made-up solution is added to till it exactly resembles the solution under trial, and the amount of addition is, of course, known exactly. Hence, the viscosity is determined by means of a solution adjusted to the same viscosity as the one under examination, and the number denoting the viscosity expresses really the number of grams of cane sugar dissolved in water and diluted up to one litre (1·76 pints) to make the test solution.

In the New York Dairy Show trials, samples of the butter from seven pure-bred

subjected to identical tests, the butter from different breeds yields different results.

Holsteins gave an average viscosity of 237, ranging from 112 to 461. Samples of the butter of seven pure-bred Jerseys averaged 74, ranging from 50 to 103. Breed peculiarities are thus clearly indicated. The average viscosity of solutions of soaps from butter fat is about 100; that of lard, tallow, oleomargarine, oil, and of all the commercial substitutes for butter exceeds 1,000; hence, this test affords a valuable means of discrimination. Nevertheless, owing to the great variation in the composition of butter, there is such a wide range in the viscosity of the solutions of butter soaps, that it is possible to adulterate the butter giving the least viscous soap as much as 30 per cent. before the higher limit for butter is passed. But by combining the viscosity test with another test known as Reichert's—which depends upon the amount of fatty acids obtained in a specified manner from 2.5 grams of butter fat—a very trustworthy result is obtained. It may be added, however, that where the viscosity number exceeds 500 there need be no doubt whatever as to adulteration; it is the butter giving viscosities of 200 to 500 that must be regarded with suspicion, which may be allayed or confirmed by applying Reichert's test.

It appears probable that the viscosity of butter soap solutions diminishes with age. Dr. Babcock tested seven samples of butter in May, shortly after churning, and again in October. The following table shows the viscosity of each sample in May, and, immediately below, the viscosity of the same sample in October:—

In May . . . . .	65, 69, 62, 61, 69, 98, 65; average 65.6.
In October . . . . .	54, 62, 62, 58, 53, 62, 54; average 57.9.

A knowledge of viscosity is of value in indicating changes in the physical constitution of milk, which are often of more importance to the dairyman than are changes in the amount of solids or of fat. Changes in the size of the fat globules or in the viscosity of the milk serum are of this character, but are not indicated by chemical analysis. A low viscosity of the milk serum (that is, the liquid part), associated with large fat globules, favours the economical production of butter. The coefficient of viscosity for the fat of milk increases with the size of the globules, hence the greater the difference between the viscosity of the whole milk and that of the skim-milk the more valuable will the milk be for the production of butter, provided the viscosity of the skim-milk is not very high.

A noteworthy fact is that when warm milk is run through a centrifugal separator, and the skim-milk and cream are caught in the same vessel and thoroughly mixed together again, the product is less viscous than the original milk. This appears to be chiefly due to the breaking up of the fat globules. The extent to which this division takes place is shown by the following determination made by Dr. Babcock of the number of fat globules before and after separation:—

	Viscosity.	Number of globules in .0001 cubic millimetre.	Per cent. of globules with diameter less than one division of the micrometer.
Milk . . . . .	267	149	52.7
After separation . . . . .	248	201	60.3
After second separation . . . . .	249	174	70.0

The effect which this division of the fat globules has upon the quantity and quality of the butter made from separated cream is not yet ascertained. Nevertheless, the peculiarity under notice may explain why the same manipulation which produces high-grade butter from ordinary cream often fails when applied to separated cream.

In explanation of the iodine number, it may be premised that the combination of the fatty acids with glycerin are called glycerides, and of these, olein, stearin, palmitin, and butyrin are examples. Now, of the fatty acids found in the glycerides of butter fat, oleic acid is the only one which has the property of absorbing iodine. Each molecule of the acid absorbs, moreover, one molecule of iodine, so that the quantity of iodine absorbed is directly proportional to the quantity of olein present. The variation in this iodine number, particularly in the butter from single cows, is very great, showing the percentage of olein in such butters to range from 27.7 to 52.1. In the New York tests the average for the Holsteins was as high as 46.19, that for the other breeds tested being 35.4 per cent. This high proportion of olein in Holstein butter may account for its softness as compared with Jersey butter. The wide range of the iodine number shows olein to be undoubtedly the

COMPARISONS OF BUTTERS FROM DIFFERENT BREEDS OF COWS.

Breed.	Iodine number.	Melting Point, Degrees Centigrade.	Viscosity number.
Jersey . . . .	31·2 . . . .	34·0 . . . .	74
Guernsey . . . .	31·5 . . . .	33·3 . . . .	110
Ayrshire . . . .	37·8 . . . .	33·5 . . . .	66
Holstein . . . .	40·0 . . . .	33·4 . . . .	237
All others . . . .	35·6 . . . .	33·8 . . . .	93
Average of all . . . .	35·6 . . . .	33·7 . . . .	127

It is obvious that the influence of the breed of the cow upon the composition of the butter fat is no less marked than it is upon the composition of the milk. Moreover, contrary to the general opinion, the quality of the butter does not appear to be materially affected by the character of the food. Among the effects of breed thus noted are those differences in butter which relate to its firmness, resistance to heat, texture or "grain," flavour, and general high quality, by reason of the presence of a larger proportion of the more delicate fats. In all these particulars butter from pure Jersey milk excels, whilst the butter from other breeds follows in the order indicated in the table just given.

It is claimed that facts such as have here been detailed show the great differences which exist in dairy products, the influence of breeds of cattle in causing these differences, and the consequent practical value of a study of this subject when selecting stock for the profitable conduct of any branch of dairying.

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## CHAPTER VI.

### OF THE MAKING AND PRESERVATION OF CHEESE.

THE character of cheese is determined not only by the quality of the milk, but by the skill of the maker, and by the general surroundings. The best season for cheesemaking is the period during which good grass is available, from May to September inclusive. In many large dairies cheese is often manufactured all the year round, but the winter cheeses are generally much inferior in quality to those made during the summer months, although it is probable that good cheese might be made throughout the year, provided the cows were well fed in the winter. Much depends on the ripeness, or mellowness, of the milk, just as in butter-making on the ripeness of the cream. Where cheese is made once a day,—the general rule,—the evening's milk, during warm weather, attains by morning a measure of ripeness

most variable constituent of butter. On the other hand, the amount of stearin in butter appears to have been largely over-estimated, for instead of 30 or 40 per cent., it is probably in most butter less than 3 per cent.

which has a good effect on the character of the cheese. In cold weather this ripening is prevented by the low temperature of the milk during the night, and hence it is, at all events in part, that the cheese of late autumn, winter, and early spring ripens slowly, and is wanting in mellowness. To obviate this, the following course was adopted by a most intelligent cheesemaker, with whom we once had a long conversation on dairying topics, in Canada:—The evening's milk, from October onwards, was warmed to about 84° F., and allowed to stand three or four hours, before being added to the next morning's milk; in this way it acquired the requisite mellowness, which it communicated to the fresh milk of the morning, and the result was that the cheese resembled summer cheese in character and sold for as much money. This question of ripening, indeed, in reference to both milk and cream, in cheese- and butter-making respectively, is one which well merits more study and investigation than it has hitherto received.

When milk has been exposed to the air for a certain time, the duration of which varies, according to the season, it becomes sour and coagulates. The curd which is thus formed may then be either made into butter, by the process of churning, as detailed in the preceding chapter, or it may be merely broken,—when the serum or whey will separate from it,—and, by means of pressure, be converted into cheese. This curd, being composed of both the caseous and the butyraceous matter, constitutes the richest, or what is commonly termed *full-milk* or *whole-milk cheese*. That produced by the curd remaining after the cream has been taken off is necessarily poorer in consequence of the abstraction of the butyraceous substance, and is termed *skim-milk cheese*.

It is known, however, that cheese manufactured from sour milk is hard and ill-flavoured, and means have been devised to curdle it while sweet. With this object various substances have been employed, but the most effectual one hitherto discovered, and consequently the most universally used, is taken from the stomach of calves, and denominated *rennet*. It is the digestive ferment secreted by glands in the internal lining membrane of the fourth stomach of that animal. Even after the animal is dead the glands remain charged with this juice, and, if the stomach is preserved from putrefaction, the fluid retains its coagulating properties for a considerable period. As a matter of fact, the maw or stomach of the calf is preserved by salting after careful cleaning. After the maw has been salted a certain time, it may be taken out and dried, and then it will retain the same property for an indefinite period. A small piece of the maw thus dried is steeped overnight in a few spoonfulls of warm water, and this water will coagulate the milk of four or five cows. Liquid rennet is now prepared of uniform strength, by those who make it a business and a study, and many cheesemakers prefer the prepared article to the crude rennet-skin, a given measure of it accurately coagulating a specified quantity of milk.

Milk coagulates with all acids, but acetic and hydrochloric acids are the most effective. If the dairyman has any reason to doubt the power of his rennet, he may always put it thus to the test. Let him take a

portion of the milk, heated to 95° F., and add a small quantity of the water in which the stomach has been soaked; by the quickness of the curdling of the milk, and the form of the flakes produced, he will, after a little experience, form a very accurate judgment of the strength of the rennet, and of the quantity which he must pour into the milk.

The methods of making cheeses in most general use in this country are detailed below, but there are many slight variations in the practice of different dairies even in the same district.

*Cheshire Cheese.*—The evening's milk is set apart until the following morning, when the cream is skimmed off. The latter is poured into a pan, which has been heated by being placed in the boiling water of a boiler. The new milk obtained early in the morning is poured into the vessel containing the previous evening's milk with the warmed cream, and the temperature of the mixture is brought to about 75° F. Into the vessel is introduced a piece of rennet, which has been kept in warm water since the preceding evening, and in which a little Spanish annatto (a quarter of an ounce is enough for a cheese of sixty pounds) is dissolved. (Marigolds, boiled in milk, are occasionally used for colouring cheese; to which they likewise impart a pleasant flavour. In winter, carrots scraped and boiled in milk, and afterwards strained, will produce a richer colour; but they should be used with moderation, on account of their taste.) The whole is now stirred together, and covered up warm for about an hour, or until it becomes curdled; it is then turned over with a bowl, and broken very small. After standing a little time, the whey is drawn from it, and as soon as the curd becomes somewhat more solid, it is cut into slices and turned over repeatedly, the better to press out the whey.

The curd is then removed from the tub, broken by hand or cut by a curd-breaker into small pieces, and put into a cheese vat, where it is strongly pressed both by hand and with weights, in order to extract the remaining whey. After this it is transferred to another vat, or into the same if it has in the meantime been well scalded, where a similar process of breaking and expressing is repeated, until all the whey is forced from it. The cheese is now turned into a third vat, previously warmed, with a cloth beneath it, and a thin hoop, or binder, put round the upper edge of the cheese, and within the sides of the vat, the cheese itself being previously enclosed in a clean cloth, and its edges placed within the vat, before transfer to the cheese-oven. These various processes occupy about six hours, and eight more are requisite for pressing the cheese, under a weight of 14 or 15 cwt. The cheese during that time should be twice turned in the vat. There are several holes bored in the vat which contains the cheese, and also in the cover of it, through which long skewers pass in every direction, the pressure being still continued. The object of this is to extract every drop of whey. The pressure soon obliterates all these punctures, and the cheese is at length taken from the vat as a firm and solid mass.

On the following morning and evening it must be again turned and pressed; and also on the third day, about the middle of which it should be removed to the salting chamber, where the outside is well rubbed

with salt, and a cloth binder passed round it, which is not turned over the upper surface. The cheese is then placed in brine, extending half-way up in a salting-tub, and the upper surface is thickly covered with salt. Here it remains for nearly a week, being turned twice in the day. It is then left to dry for two or three days, during which period it is turned once, being well salted at each turning, and cleaned every day. When taken from the brine, it is put on the salting benches, with a wooden girth round it of nearly the thickness of the cheese, where it stands a few days, during which time it is again salted and turned every day. It is next washed and dried; and, after remaining on the drying benches about seven days, it is once more washed in warm water with a brush, and wiped dry. In a couple of hours after this it is rubbed all over with sweet whey butter, which operation is afterwards frequently repeated; and, lastly, it is deposited in the cheese or store-room,—which should be moderately warm, and sheltered from the access of air, lest the cheese should crack,—and turned every day, until it has become sufficiently hard and firm. These cheeses require to be kept a long time; and, if not forced by artificial means, will scarcely be sufficiently ripe under two or three years.

As a matter of fact there are three different modes of cheese-making followed in Cheshire, known as the *early* ripening, the *medium* ripening, and the *late* ripening processes. There is also a method which produces a cheese that is permeated with “green mould” when ripe, called “Stilton Cheshire;” this, however, is confined to limited districts in the country. The early ripening method is generally followed in the spring of the year, until the middle or end of April; the medium process from that time until late autumn, or until early in June, when the late ripening process is adopted and followed until the end of September, changing again to the medium process as the season advances. The late ripening process is not found to be suitable for spring or late autumn make.

There is a decided difference between these several methods of making. In the early ripening system a larger quantity of rennet is used, more acidity is developed, and less pressure employed than in the other processes. In the medium ripening process a moderate amount of acidity is developed to cause the natural drainage of the whey from the curd when under press. In the late ripening system, on the other hand, the development of acidity is prevented as far as possible, and the whey is got out of the curd by breaking down finer, using more heat, and skewering when under press. In the Stilton Cheshire process a larger quantity of rennet is used and less pressure is employed than in the medium or late ripening systems. The various processes are fully detailed in a pamphlet (price 2*d.*) on Cheshire Cheese Making, by Mr. Joseph Rigby, published by the Royal Agricultural Society of England.

The Dutch make their cheese nearly in the same manner as the Cheshire, excepting that they substitute hydrochloric (or muriatic) acid, which imparts to *Dutch Cheese* that peculiarly sharp and salt

flavour by which it has long been characterised. They also leave out the cream.

In making *Gloucester Cheese*, the milk is poured into the proper vessel, immediately after it has been drawn from the cow; but being thought too hot in the summer, it is lowered to a temperature of about 84° or 86° Fahr. by the addition of skim-milk, or sometimes by pouring in water. The rennet is then added at the rate of a pint to 100 gallons of new, or 150 gallons of skim-milk. When the curd is ready, it is cut with the curd-breaker, this being drawn repeatedly through the mass. The whey is then taken out, the curd pressed by hand, and crumbled into small pieces like peas. The curd is next put into vats, which are submitted to the action of the press for ten minutes or a quarter of an hour, until the remaining whey is extracted. The material is then removed into the cheese-tubs, again broken small, and scalded with a pail full of water mixed with whey in the proportion of three parts of water to one of whey, and the whole briskly stirred.

This operation should be performed with great nicety, or the curd is liable to be toughened instead of simply rendered firm. The fluid intended to scald the curd should not be above 96° F., nor should the curd be warmed beyond about 84°. After standing a few minutes for the curd to settle, the liquor is strained off, and the curd collected into a vat; and when the latter is about half filled, a little salt is sprinkled over it, and worked into the cheese. The vat is now filled up, and the whole mass of cheese turned twice or thrice in it, the edges being pared, and the middle rounded at each turning. Lastly, the cheese is put into a cloth, and, after undergoing another pressure, it is carried to the shelves, where it is generally turned once a day, until it becomes sufficiently close and firm to admit of being washed.

In the manufacture of these cheeses, the curd is not so often broken as in the Cheshire—the cheese is not skewered while it is in the press, and part of the cream is usually taken away in order to make butter. The scalding is to wash out any remaining whey, or, perhaps, to dissolve any portion of butter that might have been separated before the rennet had coagulated the milk.

*Cheddar Cheese* was first made in the village of Cheddar, in the Mendip Hills, in Somersetshire. The process, as now practised, is thus described by Mr. George Gibbons in the "Journal of the Royal Agricultural Society of England," vol. xxv., second series, 1889:—

As soon as drawn, the milk should be taken to a receiver, about eighteen inches square, placed in the most convenient position outside the dairy, so that by a short open shoot it can pass through the wall into the cheese-tub, being thoroughly strained in the process, and thus doing away with the necessity of the milkers entering the dairy. The evening's milk can generally remain in the cheese-tub during the night; when the temperature is high, an occasional stirring is useful; but in damp, hot, moist weather, or during electrical disturbances, some of it should be placed in other vessels.

In the morning the first duty of the careful cheese-maker will be to



examine the condition of the night's milk, and, if acidity be perceptible, the morning's milk only should be heated; as a rule, this is advisable from about the middle of June to the end of August. The night's milk should be skimmed, and the cream put in with the milk which is to be heated in a tin vessel called a warmer, surrounded by hot water in the open boiler, in the boiler house, and in which the whey is also heated. Particular care must be taken not to exceed a temperature of  $95^{\circ}$ . By this the united milk should be raised to  $84^{\circ}$ ; but by the end of June it may be reduced to  $82^{\circ}$ . A little sour whey may be added in the earlier and later months, but its regular use cannot be recommended.

When annatto is used, it should be well stirred in, and then sufficient rennet added to coagulate the milk in sixty minutes. The intimate mixing of the milk and rennet is very important, and should usually occupy ten minutes, not only for its thorough incorporation, but also to prevent the cream rising to the surface. It is necessary that the tub should then be covered over till coagulation is complete, in order to guard against a too rapid fall in the temperature of the milk. By the time the curd will break clean over a tubular thermometer, the delicate operation of breaking should begin. This is facilitated by the use of a thin knife, long enough to reach the bottom of the tub, for cutting the curd into squares of about two inches.

This done, it should be left to harden a few minutes and for the whey to separate, when, by the use of a shovel-breaker, the splitting of the curd in its own grain commences. This at first must be done with the greatest caution, or the whey will get white and loss of quality ensue; but the speed should increase as the curd hardens—always taking care that it is regularly broken, and not smashed, until it is the size of a pea, and the whey of a greenish hue; the time of this operation depends somewhat upon the quantity dealt with, but it should take from fifty to sixty minutes. The mass should now be allowed to settle for ten minutes, when with a syphon sufficient whey may be drawn off, as, when heated to not more than  $130^{\circ}$ , would raise the whole to  $90^{\circ}$ . During the application of this whey the curd should be well stirred and mixed. A further rest of ten minutes takes place, when enough whey should be drawn off for heating to  $130^{\circ}$ , and the whey in the tub lowered till it only covers the curd by about two inches. The heated whey should now be poured in a small stream over the curd, the operator taking the utmost care that the whole mass is thoroughly broken up and incorporated with it, the thermometer being frequently used, until it stands at  $100^{\circ}$ , the limit desired; but the stirring must be continued until the curd becomes shotty and is disposed to sink, the whey showing above it clear and green.

This operation may take from ten to thirty minutes, but should the curd not harden sufficiently fast, and the temperature fall quickly, it would be well to add more hot whey, so as to retain the heat at  $100^{\circ}$ . The curd may now rest thirty minutes (or, if it is sufficiently acid, a shorter period will do), when all the whey may be let off, and the curd piled as high as possible in the centre of the tub. Carefully wash down all crumbs, strain, and place them on top of the mound. Cover and

keep it warm with cloths until it has become sufficiently solid to cut into large pieces which can be turned over without breaking. When this has been done, the whole should be again piled and kept covered for thirty minutes longer, as before; after this it may be removed to the curd-cooler, cut into smaller pieces, and again piled and covered for thirty minutes. This cutting, changing, piling, and covering is continued until the curd presents a rich, dry, mellow, solid appearance, and a perceptible amount of acidity has been developed. This is easily ascertained by taste and smell. It is now ground, and should present a ragged solid curd, dry, but greasy, and if several pieces are pressed together by the hand the fragments should easily fall apart. Fine clean dry salt should be used at the rate of  $2\frac{1}{2}$  lb. per 112 lb. of curd, and thoroughly mixed with it.

At this point the temperature of the curd should not be below  $70^{\circ}$ , and it should be put into the vat or mould, lined with a thin cloth large enough to cover the cheese, placed in the press, where it has a pressure of about 20 cwt., and allowed to remain there until the next morning, when the cloth should be changed, the position of the cheese inverted, and replaced in the press until the following morning. A little fat rubbed over it softens the surface, and is useful in preventing cracks, a square piece of muslin being placed on its top and bottom, and the sides also completely covered with the same material, of sufficient width to draw over the squares  $1\frac{1}{2}$  inch, to which it should be neatly sewn. Replace the cheese in the press, where it should continue two days longer. It should then be stoutly bandaged and removed to the warm cheese-room, whence, after being turned daily for six weeks, it should be taken to the cooler room, and turned every other day until three months old, after which, turning once every four or five days is sufficient. Much trouble and damage to the cheese is saved by the use of vats, which open with a key, as made by Brown, of Shepton Mallet, Somerset.

Some successful makers scald at a lower temperature, only raising the first scald to  $86^{\circ}$  or  $88^{\circ}$  by whey heated to  $120^{\circ}$ , stirring the curd to assist the hardening fifteen or twenty minutes. The temperature of the second scald should be  $98^{\circ}$ , by whey heated to  $130^{\circ}$ , and it should be stirred until the curd is shotty. It should then be left for twenty minutes, or less, if acidity develops fast. In this case no whey is removed from the curd previous to scalding, except what is required for heating. After the expiration of the time of rest, let all the whey run off; then the usual course is to place the curd in the centre, cutting, turning, covering, and keeping warm, putting it on a rack to drain, placing a board and heavy weights on it to facilitate separation of the whey, promote acidity, and produce a solid curd.

The foregoing descriptions of the manufacture of Cheddar Cheese may be generally followed on small or medium-sized dairy farms; but where large quantities of milk are dealt with, a saving of the heavy laborious work entailed in the lifting and carrying the whey to be heated to and from the boiler is most desirable. As the heating of the milk and whey in the cheese-tub by steam or water is not generally

favoured, an improved system, which combines the minimum of labour with the highest results of manufacture, is effected by the use of appliances (fig. 71) made by Mr. E. S. Hindley, of Bourton, Dorset. By this system the quantity of milk or whey required for heating is raised by means of a small centrifugal pump to a tin or copper-tinned vessel called the heater, placed on a level with the top of the tub and partly overhanging it. This has a double bottom, into which steam is introduced. A suitable size for a sixty-cow dairy would be  $4\frac{1}{2}$  feet by  $2\frac{1}{2}$  feet, and 1 foot deep, thus easily containing 60 gallons. The milk in it can be quickly heated to  $95^{\circ}$ , which it should never exceed. Then by the opening of a tap it passes into the tub for raising its contents to

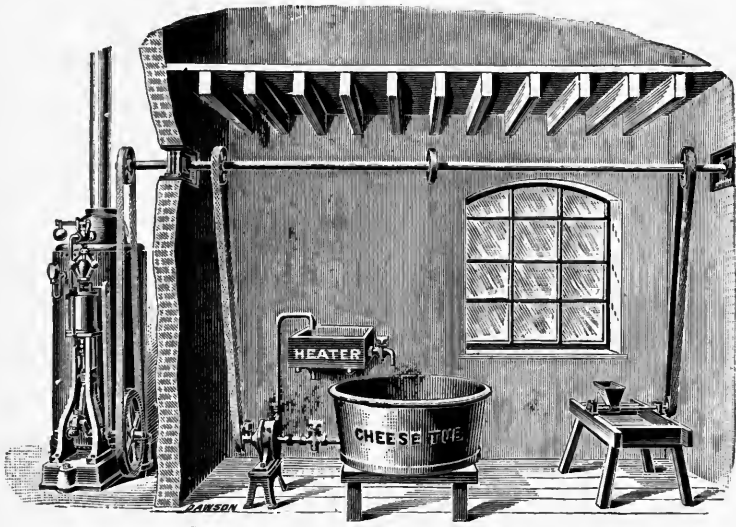


Fig. 71.—Appliances for Making Cheddar Cheese.

the required temperature for renneting, say  $84^{\circ}$  for the early months, and  $82^{\circ}$  or  $83^{\circ}$  later on. The operation of breaking proceeds as before described, but the whey is raised by the same pump into the heater for scalding, and discharged over the curd in the cheese-tub. The lifting and heating of the whey and milk are effected rapidly and without any manual labour, as the pump is worked from a shaft driven by a small steam-engine, the boiler of which supplies the steam to the heater. It also heats all hot water needed, and supplies a jet of steam, which is very useful in the thorough cleansing of utensils. The pump can be cleaned without difficulty, by passing steam and water through it. The shaft also affords a ready means of driving the curd-mill, placed over the curd-cooler; and in those dairies where butter is made, the power is available for driving the separator, churn, and butter-worker. The immense saving of time and trouble, and the certainty with which good

results can be obtained by this efficient and comparatively inexpensive system are its chief recommendations.

In a well-managed dairy, where the cheese is properly cured as described, the thin cloths and bandages can be kept on the cheese for transit, as there is thus much less chance of damage; and when the cloth is removed by the retailer or consumer, the cheese should open free from mould, mites, or cracks; and should possess fine mellow texture, sweet aromatic flavour, and pure rich buttery quality, retaining these characteristics if kept for years.

The Canadian system of making Cheddar cheese has, within recent years, attracted considerable attention in this country, and especially has been pursued with marked success in Scotland. The following remarks, contained in a paper on "Cheese-making in Ayrshire," read before the conference of the British Dairy Farmers' Association in 1889, by Mr. R. J. Drummond, are quoted from the "North British Agriculturist":—"In the year 1885 I was engaged as cheese instructor by the Ayrshire Dairy Association, to teach the Canadian system of Cheddar cheese-making. I commenced operations under many difficulties, being a total stranger to both the people and the country: and with this, the quantities of milk were very much less than what I had been in the habit of handling. Instead of having the milk from 500 to 1000 cows, we had to operate with the milk from 25, and not over 60 cows. As a rule I found the people very much prejudiced against anything American; to them it seemed an absurd idea to have to bring an American over to teach the mother country how to improve her cheese.

"The system of cheese-making commonly practised in the county of Ayr at that time was what is commonly known as the Joseph Harding or English Cheddar system, which differs from the Canadian system in many details, and in one particular is essentially different,—viz., the manner in which the necessary acidity in the milk is produced. In the old method a certain quantity of sour whey was added to the milk each day before adding the rennet, and I have no doubt, in my own mind, that this whey was often added when the milk was already acid enough, and the consequence was a spoiled cheese.

"Another objection to this system of adding sour whey was, should the stuff be out of condition one day, the same trouble was inoculated with the milk from day to day, and the result was sure to be great unevenness in the quality of the cheese. The utensils commonly in use were very different to anything I had ever seen before; instead of the oblong cheese vat with double casings, as is used by all the best makers at the present time, a tub, sometimes of tin and sometimes of wood, from 4 to 7 feet in diameter by about 30 inches deep, was universally in use. Instead of being able to heat the milk with warm water or steam, as is commonly done now, a large can of a capacity of from 20 to 30 gallons was filled with cold milk and placed in a common hot-water boiler, and heated sufficiently to bring the whole body of milk in the tub to the desired temperature for adding the rennet. I found that many mistakes were made in the quantity of rennet used, as

scarcely any two makers used the same quantity to a given quantity of milk. Instead of having a graduated measure for measuring the rennet, a common tea cup was used for this purpose, and I have found in some dairies as low as 3 oz. of rennet was used to 100 gallons of milk, where in others as high as 6½ oz. was used to the same quantity. This of itself would cause a difference in the quality of the cheese.

“Coagulation and breaking completed, the second heating was effected by dipping the whey from the curd into the can already mentioned, and heated to a temperature of 140° F., and returned to the curd, and thus the process was carried on till the desired temperature was reached. This mode of heating I considered very laborious, and, at the same time, very unsatisfactory, as it is impossible to distribute the heat as evenly through the curd in this way as by heating either with hot water or steam. The other general features of the method do not differ from our own very materially, with the exception that in the old method the curd was allowed to mature in the bottom of the tub, where at the same stage we remove the curd from the vat to what we call a curd-cooler made with a sparred bottom, so as to allow the whey to separate from the curd during the maturing or ripening process. In regard to the quality of cheese on the one method compared with the other, I think that there was some cheese just as fine made in the old way as anything we can possibly make in the new, with one exception, and that is, that the cheese made according to the old method will not toast; instead of the casein melting down with the butter fat, the two become separated, which is very much objected to by the consumer, and, with this, want of uniformity through the whole dairy. This is a very short and imperfect description of how the cheese was made at the time I came into Ayrshire; and I will now give a short description of the system that has been taught by myself for the past four years, and has been the means of bringing this county so prominently to the front as one of the best cheese-making counties in Britain.

“Our duty in this system of cheese-making begins the night before, in having the milk properly set and cooled according to the temperature of the atmosphere, so as to arrive at a given heat the next morning. Our object in this is to secure, at the time we wish to begin work in the morning, that degree of acidity or ripeness essential to the success of the whole operation. We cannot give any definite guide to makers how, or in what quantities, to set their milk, as the whole thing depends on the good judgment of the operator. If he finds that his milk works best at a temperature of 68° F. in the morning, his study the night before should tend toward such a result, and he will soon learn by experience how best to manage the milk in his own individual dairy. I have found in some dairies that the milk worked quite fast enough at a temperature of 64° in the morning, where in others the milk set in the same way would be very much out of condition by being too sweet, causing hours of delay before matured enough to add the rennet. Great care should be taken at this point, making sure that the milk is properly matured before the rennet is

added, as impatience at this stage often causes hours of delay in the making of a cheese. I advise taking about six hours from the time the rennet is added till the curd is ready for salting, which means a six hours process; if much longer than this, I have found by experience that it is impossible to obtain the best results. The cream should always be removed from the night's milk in the morning and heated to a temperature of about 84° before returning it to the vat. To do this properly and with safety, the cream should be heated by adding about two-thirds of warm milk as it comes from the cow, to one-third of cream, and passed through the ordinary milk strainers. If colouring matter is used, it should be added fifteen to twenty minutes before the rennet, so as to become thoroughly mingled with the milk before coagulation takes place.

"We use from 4 to 4½ oz. of Hansen's rennet extract to each 100 gallons of milk, at a temperature of 86° in spring and 84° in summer, or enough to coagulate milk firm enough to cut in about forty minutes when in a proper condition. In cutting, great care should be taken not to bruise the curd. I cut lengthwise, then across with perpendicular knife, then with horizontal knife the same way as the perpendicular, leaving the curd in small cubes about the size of ordinary peas. Stirring with the hands should begin immediately after cutting, and continue for ten to fifteen minutes prior to the application of heat. At this stage we use a rake instead of the hands for stirring the curd during the heated process, which lasts about one hour from time of beginning until the desired temperature of 100° or 102° is reached. After heating, the curd should be stirred another twenty minutes, so as to become properly firm before allowing it to settle. We like the curd to lie in the whey fully one hour after allowing it to settle before it is ready for drawing the whey, which is regulated altogether by the condition of the milk at the time the rennet is added. At the first indication of acid, the whey should be removed as quickly as possible. I think at this point lies the greatest secret of cheese-making,—to know when to draw the whey."

"I depend entirely on the hot iron test at this stage, as I consider it the most accurate and reliable guide known to determine when the proper acidity has been developed. To apply this test, take a piece of steel bar about 18 inches long by an inch wide and ¼ inch thick, and heat to a black heat; if the iron is too hot, it will burn the curd, if too cold, it will not stick, consequently it is a very simple matter to determine the proper heat. Take a small quantity of the curd from the vat, and compress it tightly in the hand, so as to expel all the whey; press the curd against the iron, and when acid enough, it will draw fine silky threads ¼ inch long. At this stage the curd should be removed to the curd-cooler as quickly as possible, and stirred till dry enough to allow it to mat, which generally takes from five to eight minutes. The curd is now allowed to stand in one end of the cooler for thirty minutes, when it is cut into pieces from 6 to 8 inches square, and turned, and so on every half-hour until it is fit for milling. After removing the whey, a new acid makes its appearance in the body of the

curd, which seems to depend for its development upon the action of the air, and the presence of which experience has showed to be an essential element in the making of a cheese. This acid should be allowed to develop properly before the addition of salt. To determine when the curd is ready for salting, the hot iron test is again resorted to, and when the curd will draw fine silky threads  $1\frac{1}{2}$  inches long, and at the same time have a soft velvety feel when pressed in the hand, the butter fat will not separate with the whey from the curd. I generally advise using 1 lb. of salt to 50 lb. of curd, more or less, according to the condition of the curd. After salting we allow the curd to lie fifteen minutes, so as to allow the salt to be thoroughly dissolved before pressing.

"In the pressing, care should be taken not to press the curd too severely at first, as you are apt to lose some of the butter fat, and with this I do not think that the whey will come away so freely by heavy pressing at first. We advise three days' pressing before cheese is taken to the curing-room. All cheese should have a bath in water at a temperature of  $120^{\circ}$  next morning after being made, so as to form a good skin to prevent cracking or chipping. The temperature of the curing room should be kept as near  $60^{\circ}$  as possible at all seasons of the year, and I think it a good plan to ventilate while heating.

"Too much stress cannot be laid on the fact that milk must be pure to obtain satisfactory results. Impurities in milk affect unfavourably not only the value of its products as articles of diet, but the very process which gives the products. At the Dairy Institute near Kilmarnock, we pay the strictest attention to the milking of the cows, to see that each milker washes his hands after the milking of each cow, and, at the same time, the milk is all carefully strained in the byre, and again when delivered in the dairy. The kind of cheese we aim at making is a close cutting, fine flavoured, mild cheese, with good body, and a good cheese in two and a half months, or one that will keep a year."

Reference may here be made to two papers on "Pure Cultures for Cheddar Cheese-Making," by Professor J. R. Campbell, in the "Transactions of the Highland and Agricultural Society of Scotland," 5th series, vol. viii. (1898) and vol. ix. (1899). In the latter volume (p. 219) two important discoveries were announced. The first of these is the fact that it is well within the power of any dairyman to prepare what is practically a pure culture of the same bacterium as that which it had been customary to supply from the laboratory. "The second discovery is that the sour-whey starter, used by some of the successful cheese-makers before the introduction of the American system, was practically a pure culture. These men had, therefore, by empirical methods, attained the same end as that to which we have been led by the more accurate guidance of bacteriological research."

*Stilton Cheese* has only been introduced since the middle of the eighteenth century. It was first manufactured by a Mrs. Paulet, who resided in the Melton quarter of Leicestershire, and who, being a relative of the landlord of the Bell Inn, at Stilton, on the great North Road, supplied

his house with cheese of such singularly superior quality, that it came into demand beyond the consumption of the house, and was sold for as much as half-a-crown a pound.<sup>1</sup> It thus acquired the name of Stilton Cheese; but the mode of making it having been soon discovered, it is now generally manufactured through all the neighbouring counties, and the sale is no longer confined to that place. A great deal of imitation Stilton cheese comes to market, which, though good, is of a very inferior quality to the real Stilton. Its richness depends both on the breed of cows employed, and the quality of the pasture on which they are fed, but especially upon the quantity of *cream* used in the manufacture of it; for, unless a large portion of this is added to the milk, the cheese will be deficient in the essential qualities for which it is celebrated.

For the making of Stilton cheese it is essential that the milk be that of cows fed on good old grass pastures—which ought to have a clay subsoil—supplemented, it may be, by a little cake, say, about 2 lb. per cow per day. It is not advisable to attempt Siltons at all on a very poor pasture, whilst a very rich pasture should be avoided by all but the most expert cheese-makers. A true Stilton, it is well to remember, is not made from unskimmed milk only, but has a certain amount of cream added to it.

The evening's milk is cooled to 65° F. at the time of milking, by means of Laurence's refrigerator, and set until morning in a tin vessel 8 inches deep, 28 inches wide, and 40 inches long, having a hole in the bottom closed with a plug, the stem of which is long enough to stand above the milk when the vessel is full. This must rest on a wood frame 18 inches high, to admit of a bucket being placed underneath in which to draw off the milk.

In the morning draw off one-sixth of the milk through the plughole and put it out of the way (this should not be put in the setting-pan); then draw off a tin bucket full and immerse it in hot water till it is raised to 110° F., stirring occasionally to prevent skimming on the top. Pour it in the setting-pan, draw off another bucketful, and treat in the same way until the vessel is empty. The cream which is left

<sup>1</sup> In "Marshall's Rural Economy of the Midlands," published in 1790; it is stated (2nd edit. vol. i. p. 320):—"Leicestershire is at present celebrated for its cream cheese, known by the name of Stilton cheese. This species of cheese may be said to be a modern produce of the Midland district. Mrs. Paulet, of Wymondham, in the Melton quarter of Leicestershire, the first maker of Stilton cheese, is still [1790] living. Mrs. P., being a relation or acquaintance of the well-known Cooper Thornhill, who formerly kept the Bell at Stilton (in Huntingdonshire, on the great North road from London to Edinburgh), furnished his house with cream cheese; which, being of singularly fine quality, was coveted by his customers; and, through the assistance of Mrs. P., his customers were gratified, at the expense of half-a-crown a pound, with cream cheese of a superior quality, but of what county was not publicly known. Hence it obtained, of course, the name of Stilton cheese. At length, however, the place of produce was discovered, and the art of producing it learnt, by other dairymen in the neighbourhood. Dalby first took the lead; but it is now made in almost every village in that quarter of Leicestershire, as well as in the neighbouring villages of Rutlandshire. Many tons are made every year. Dalby is said to pay its rent from this produce only. Thus, from a mere circumstance, the produce of an extent of country is changed; and, in this case, very profitably. The sale is no longer confined to Stilton; every innkeeper within fifteen or twenty miles of the district of manufacture is a dealer in Stilton cheese. The price at present is tenpence a pound to the maker, and a shilling to the consumer, who takes it at the maker's weight."



till last must not be raised higher than 98°. Add the whole of the morning's milk after it has been drawn from the cows half an hour, care being taken that the cream does not rise on the new milk—this can be prevented by an occasional slight stirring.

The milk in the setting-pan should be 84° or 86°, according as the outside temperature is high or low at the time the rennet is added. Care must be taken to mix thoroughly, and the pan is covered with a light cloth to prevent the heat escaping. Home-made rennet is usually employed, but Hansen's rennet tablets answer equally as well, though they are more costly.

The milk will be coagulated in from ten to fifteen minutes. In two and a half hours from setting, the curd will be ready to put in the draining-trough; this is done by gently ladling, with a shallow tin bowl holding about half a gallon, the whole contents of the setting-pan into the draining-trough (rods of iron or wood must be placed across the top of the draining-trough to carry the edges of the strainering), in which a piece of *wet* strainering about 48 inches square has been previously placed to receive it. One piece of strainer will hold the curd of about seven gallons of milk.

When the curd is all in the draining-trough, the four corners of the strainer are tied loosely together: the whey remains in the trough half or three-quarters of an hour before drawing off. The curd must then be tied more tightly, which is done by placing the four corners of the strainer together. Very great care must be taken *not to crush* the curd at any time, or the whey will run white, whereas the main object is to keep the whey as green as possible.

The tying will need repeating three or four times during the day, until the curd is sufficiently firm to cut into blocks of the size of half a brick, which will be from six to seven hours from ladling. The pieces must be laid over the bottom of the trough, and in two hours each piece must be carefully turned over, and the whole covered with a light cotton cloth until the following morning. It is now ready to put in the mould (or hoop), but, before doing so, the pieces must be broken to the size of a walnut, mixing salt in the proportion of 8 oz. of salt to 30 lb. of curd. When the hoop is being filled, the curd in the hoop should be occasionally lightly pressed with the hand, and when full it must at once be taken to the draining-room and put in the drainer. Before commencing to fill the hoop it will be necessary to place the latter upon a piece of board, on which to carry it to the drainer; a sinker made of wood, and just sufficiently large to pass easily *inside* the mould, being placed on the top of the curd. As a rule, no other weight should be used, though sometimes it is necessary to do so. No directions as to weights can safely be given, the knowledge must be gained by experience and observation.

After standing three hours, the mould containing the cheese must be turned over on its opposite end, the sinker again being placed on the top. This must be repeated at regular intervals three times a day. At each time of turning on the second and two or three succeeding days the cheese must be skewered through the perforations

in the sides of the hoop with a steel skewer about twice the thickness of an ordinary knitting-pin: the outside of the mould containing the cheese must be washed with tepid water, and the drainer thoroughly brushed and washed with hot water every morning.

If the temperature has been kept uniformly at 65°, and the turning and skewering have been properly attended to, the cheese will be ready for the binder about six days from making—here again no precise instructions can be given. The cheese should feel rather elastic under pressure of the fingers; it will also have left the sides of the mould slightly, so that the latter easily slips off. When the maker is satisfied the cheese is ready for the binder—which is a piece of calico as broad as the cheese is high, and an inch or two longer than will encircle it—the mould containing the cheese is placed on a table, the mould is taken off, and the little holes in the sides of the cheese are filled up by slowly drawing the flat side of a table-knife up and down, applying a slight pressure in doing so, till the side of the cheese is smooth and even.

The binder is now tightly pinned around, and the mould, after being thoroughly cleansed, is again placed over the cheese. The next day this binder must be replaced by a clean one, the side of the cheese being again rubbed over with the knife, and the mould replaced. A clean binder must be put on every day, the mould being discarded after the second day. In very drying weather a light covering must be used for all cheeses in binders.

On the first appearance of coat the knife must no longer be used. In about six or eight days the binder will begin to have dry places upon it, which is a sign the coat is beginning to form. To the eye it will look like little white crinkled patches, but in a few days it will spread all over the cheese, and the coat will then be fully formed. The binder must be used until the coat is perfect.

In very damp thundery weather “slip-cote”—a soft greasy state of the cheese, which will very soon be known by experience—will form instead of the true coat; this must be scraped off with the knife as soon as perceived, and the cheese removed to a cooler place. The best place for the coating process is the setting-dairy, on shelves placed along the wall, except in very hot weather, when a cool moist room is best, with a temperature of about 55° F. The storing-room, which at this time is not fully occupied, is a good place, if care is taken to exclude the midday air.

When the coat is fully formed the cheese must be taken to the drying-room, and placed on deal shelves. It now only requires turning every day, careful attention being paid to cleanliness and draughts. The draught should be rather dry and free, but care must be taken that it is not too free, or cracking of the coat will take place. This latter must be studiously avoided, otherwise the small cheese-fly will deposit its larva in the tiny cracks, and the cheese will be spoilt. The coat should be kept in the same white state as when it came out of the binder. If there is too much moisture in the atmosphere a black mould will form on the coat. This should not be allowed; more dry

air must be admitted, and the cheeses placed farther apart on the shelves. After the cheese has been in the drying-room about twenty days the coat will be firmly fixed, and the cheese must go to the storing-room, to be placed in rows on deal shelves. Here it will only require daily turning, but the shelves must be kept quite clean and free from mites, and careful attention must still be paid to draughts and temperature. In summer it is necessary to exclude the light at mid-day.

Stilton cheeses are sometimes not sufficiently mellowed until they are two years old; and are not accounted to be in good order unless they are decayed, blue, and moist. It is said that small pieces of a mouldy cheese are often inserted into them by means of a *taster*, and that wine or ale is frequently poured over them. Large caulking-pins are also stuck into them to produce the requisite mouldiness. Much of this is bad policy, for the highest perfection is attained when the inside becomes almost as soft as butter and there is not any blue mould save that which develops during the ripening of the cheese.

A Stilton cheese is generally ready for the table in about six months from making. When ready it should have a crinkled light drab coat, it should cut easily with a knife, and if bored it should leave some of the rich soft cheese upon the surface of the borer. It should be well veined with blue, and have a flavour and aroma not to be found in any other cheese of British or foreign make.

For the most recent information the reader is referred to Mr J. Marshall Dugdale's paper on "Stilton Cheese" in the Journal of the Royal Agricultural Society of England, vol. x. (3rd series), 1899.

In making *Wiltshire Cheese*, the milk is used as soon as it is brought from the cow; or, if the temperature is too high, it is lowered by the addition of a little skim-milk. The curd is, in the first place, broken with the hand to various degrees of fineness, according to the kind of cheese intended to be made. For *thin* cheese, it is not reduced so fine as in the Gloucestershire; for the *thick* kind, it is broken still finer; and for *loaves* it is almost crushed to atoms. In the first breaking of the curd, care is taken to let the whey run gradually off, lest it should carry with it more or less of the butter-fat. As the whey rises, it is poured off, and the curd pressed and pared or cut down, three or four times, in slices of about an inch thick, in order that all the whey may be extracted. It is then scalded in the same manner as the Gloucester cheese. In some dairies it is the practice, after the whey is separated, to re-break the curd, and salt it in the liquor; but in others it is taken out of the liquor while warm, and then salted in the vat. The thin sorts are disposed of, with a small handful of salt, in one layer; thick cheeses, with two handfuls, in two layers; and loaves, with the same quantity, in three or four layers, the salt being spread and uniformly rubbed into the curd. In general, Wiltshire cheese is twice salted in the press, beneath which it continues, according to its thickness.

Dunlop cheesemaking, once general in the south-western counties of Scotland, has been almost wholly extinguished by the Cheddar system, which was introduced into Scotland by Harding of Marksbury (*see*

page 326), soon after the middle of the nineteenth century, and it may be doubted if now there are any people left who make Dunlop cheese. The Cheddar system, indeed, has taken deep root in Scotland, as in many other countries, and Scotch Cheddars have a high reputation in the English market. The Cheddar system is cosmopolitan in its adaptiveness,—far more so than any other.

First Class *Leicestershire Cheese* cannot be surpassed, either in quality or the price it will command, save perhaps by the best Cheddars and the genuine Stiltons. Low-lying land, having a cold, marly sub-soil, carrying a few rushes here and there, and not having been ploughed for a century or two, if ever—land, indeed, whose herbage is ancient and indigenous to the soil—is believed to produce the finest qualities of cheese, whose flavour is rich, clean, full, whose texture is firm and flaky, rather than waxy, and whose mellowness is attractive to the connoisseur in cheese. The methods on which it is made vary a good deal, and each dairymaid follows her own ideas. In spring and autumn the milk is “set” for coagulation at 80° to 84° F., and in summer at 76° to 78°, sufficient rennet being employed to coagulate it in an hour and a quarter or so. Success depends on extracting all the whey, and in curing well without over-salting. The cheese is salted partly in the curd, and partly on the outside of the newly-formed cheese.

*Derbyshire Cheese*, made on the Carboniferous Limestone soil in the northern half of the county, is a good, practical, sound, every-day article of food, sometimes as excellent and attractive as the Leicestershire cheese. It is made in a similar manner, but the salting is all done on the outside. Mr. George Sheldon, of Low Fields, Derbyshire, made the useful and valuable discovery that the cheese was greatly improved by the addition of about one-fifth of the previous day's curd, which had been allowed to become more or less acid. The discovery was accidental, a few pounds of curd having been mislaid; but the whole year's cheese, upwards of six tons, made in that way, realized 87s. per cwt. The milk is coagulated at about 80° F., and in an hour; the curd is then broken, and the whey extracted,—the latter by repeated cutting, “crimming,” and pressure—the cheese is in press three or four days, or a week, being turned and dry-clothed once or twice a-day, after which it is taken to the room over the kitchen to ripen. Excellent cheese is made in the Fylde of Lancashire, much on the foregoing plan, the best dairies using sour curd as Mr. Sheldon did in Derbyshire.

*Green Cheese* is made by steeping in milk two parts of sage with one of marigold leaves and a little parsley, all well bruised; and then mixing it with the curd which is prepared for the press. It may be mixed irregularly or fancifully, according to the pleasure of the maker. The management is in other respects the same as for ordinary cheese. Green cheeses are manufactured in various counties, but only to a small extent.

*Skim Cheese* was formerly made in the county of Suffolk, whence it was often called *Suffolk Cheese*. The curd is broken in the whey, which is poured off as soon as the former has subsided. The remain-

ing whey, together with the curd, being thrown into a coarse strainer, and exposed for cooling, is then pressed as closely as possible. It is afterwards put into a vat, and again pressed for a few minutes, in order to extract the remaining whey. The curd being thus drained from the whey, is taken out once more, broken as finely as possible, salted, and submitted to the press. The other operations do not materially vary from those adopted in the cheese-making districts; but they are more easily performed on the curd of skim-milk, as it is more readily coagulated and separated from the whey, and requires less subsequent care and pressure than that of milk and cream united. The Suffolk cheese used to form, in general, part of every ship's stores, because it resisted the effects of warm climates better than most others; but it was characterized by "a horny hardness and indigestible quality." A better kind is made in *Dorsetshire*, although the only perceptible difference in management consists in the rennet and the milk being put together cooler; for, by having the milk hot, and immediately applying the rennet, the whey drains so quickly as to impoverish the cheese and render it tough. The old Suffolk cheese was known as "Bang and Thump," and a local rhymester thus described it:—

"Those that made me were uncivil,  
For they made me harder than the devil.  
Knives won't cut me; fire won't sweat me;  
Dogs bark at me, but cannot eat me."

And the poet Bloomfield said that Suffolk cheese

"Mocks the weak effort of the bending blade;  
Or in the hog-trough rests in perfect spite,  
Too big to swallow, and too hard to bite."

Whereupon we may conclude that the cheese of the county had a reputation peculiarly its own.

*Cream Cheese* is generally made in August or September, the milk being at that time richer and better than at other periods. It may, however, be successfully made at almost any time. Cream cheeses are more liable to accident than the poorer sorts, from being chilled or frozen before they become hard, for when the frost once penetrates a cheese of this kind it destroys every good quality, and either makes it ill-tasted or generates putrefaction. Hence, this kind of cheese should always be kept in a warm situation, and particularly preserved from the frost, until it has sweated well, otherwise all the advantage of its rich quality will be completely lost. Cream cheese, however, is in general only wanted for immediate use; and that kind commonly so called is, in fact, nothing else than thick cream drained, and put into a small cheese-vat about an inch and a half in depth, having holes in the bottom to allow any liquid that may exude to pass, and having rushes, or the long grass of Indian corn, so disposed around the cheese, as to admit of its being turned without being broken. It is thus that the celebrated *Bath* and *York* cream cheeses are made, but the greater number of those commonly sold are composed of milk.

Cream cheese, it is obvious, is not "cheese" in the true sense of

the term, for it is not coagulated casein, nor is rennet used in its manufacture.

The process of making any kind of cheese, except cream cheese, is much more difficult than that of manufacturing butter, and the quality depends as much, perhaps, on the mode of performing the various operations as on the richness of the milk. The temperature at which the milk is kept before it is formed into cheese, and that at which it is coagulated or turned into curd, are objects of considerable importance in the management of a cheese dairy: the former should not exceed 60° F. nor fall below 50°, and for the latter it should be occasionally from 78° to 82°. If the milk is kept too warm it is apt to become sour, and to give a bad taste to the cheese. If it is allowed to be much colder it becomes difficult to separate the curd from the whey, and the cheese made from it will be soft and insipid. If the curd is coagulated too hot, it becomes tough; much of the butyraceous matter is carried off with the whey, and the cheese is hard and tasteless. The thermometer should, therefore, be employed in every dairy, and, although the servants may at first be prejudiced against it, its evident utility and great simplicity will eventually reconcile them to its use.

The greatest care should be taken to thoroughly extract the whey from the curd, for cheese is apt to heave where any whey remains; and if any part becomes sour, the whole will acquire a disagreeable flavour. Similar effects are produced by the use of an immoderate quantity of rennet. It is also apt to fill the cheese with small vesicles or holes, which imperfection will likewise be produced if the cheese is allowed to remain too long on one side or end.

The cracking of cheese usually arises from the exterior drying too fast, before the interior has become firm. This is commonly caused by the atmosphere of the cheese-room being kept too dry, and at too high a temperature.

Various kinds of *Soft Cheese*,—Camembert, Brie, Neuchâtel, and a score of others which differ more in name than in character,—are made in France and Germany, and some of our ardent reformers have advocated the extensive manufacture of such cheese in England. It is well, however, before rushing into any new practice to reflect whether the public will support it by purchasing the product freely. The French and Germans feed very differently from, and as a rule not half as well as, the English, and the cheeses they prefer are more a relish than a food, far inferior in nutritive value, pound for pound, to the solid, well preserved cheeses of Great Britain. The Continental soft cheeses, too, keep good only a few days, and any falling-off in demand would result in serious loss. The tastes and habits of a nation are not changed in a year, and so far the demand in England for soft cheese of any kind has been, comparatively to that for hard cheese, practically non-existent. The *Slipcote Cheese* of Rutland is, nearer than any other we have, rather like some of the soft cheeses on the other side of the Channel; it has been made during a long period, but so far the demand for it is small. Therefore, it does not appear likely that the soft cheese industry can be held out to our farmers as a tempting pursuit.

Two points of considerable practical interest in the processes of cheese-making are referred to by Mr. George Gibbons in his paper on "Cheddar Cheese Making," both being due to the skill of Dr. F. T. Bond of Gloucester. The first consists in a method of determining the curdling point of milk that has been renneted, with a precision which has not been hitherto attainable. It is founded upon the fact that whilst a drop of ordinary milk, or even of milk that has been renneted up to a certain stage, when allowed to fall gently on the surface of water in a glass vessel, breaks up into rings, and ultimately diffuses completely through the water, yet at a certain point in the development of the curd, which Dr. Bond states has a definite relation to the period when it becomes fit for cutting, the drop falls in a solid mass through the water. This takes place so rapidly as to be distinctly evident within one minute, and Dr. Bond claims that it gives a fixed point by which the effect of rennet can be measured, with a delicacy that is made greater than that of any other method hitherto in use. It is clear that, if this be so, the cheese-maker has at his disposal a simple method by which he can not only measure the strength of any given sample of rennet, but can determine its effects on any given sample or bulk of milk, with much more precision than hitherto, since the tests usually employed for estimating the fitness of the curd for cutting, though sufficient for this purpose, are not exact enough to allow of their being used to measure the strength of rennet with any delicacy.

The practical cheese-maker is recommended to study two papers by Dr. Bond—the one on "Acidity in Milk," the other on "The Work of Acidity in Cheese-making"—in the "Journal of the Royal Agricultural Society," vol. ii., 3rd series, 1891; also his paper on "Germs in the Dairy" in the same Journal, vol. vii., 1896.

The second contribution referred to, is a method of measuring the acidity of milk, whey, &c., by the use of a standard solution of an alkali combined with a colouring agent called an *indicator*. This method, which is familiar in the chemical laboratory, has been adopted by Dr. Bond for use in the dairy, in a way which makes it easily workable by any intelligent person who will take a little trouble to master its details. The control of acidity in cheese-making is a problem which has puzzled many a maker, and if further investigation should confirm the trustworthiness of this method and its applicability to general use, there can be no doubt that the claim which Dr. Bond makes to have added by these two contributions to the precision with which cheese-making can be conducted, will be fully substantiated.

A new kind of cheese, called "Oleomargarine Cheese," has been recently invented in American dairies,—the object being to economize the skim-milk by using lard and other fat of animals to replace the butter taken away in the skimming. The following description we borrow from the pages of "The Farmer":—

"This cheese is made from milk which has been set for cream and skimmed, the cream being turned into butter, and oleomargarine added to replace the material fat of the milk which has been taken off for butter making. The object of adding oleomargarine is to so improve

the skim-milk that a cheese may be made from it which is mellow and palatable, and which will resemble in texture and meatiness a whole-milk cheese. Oleomargarine can be bought at about 14 cents per pound, and as a much less quantity is added to the skim-milk than the original butter taken off, the difference in price as well as quantity of the two articles constitutes the profit to be derived from the management of milk on this system as compared with whole-milk cheese-making.

“But, first, how is oleomargarine made? A gentleman who has recently paid a visit to an oleomargarine factory in Hartford, Connecticut, writing in an American contemporary, says:—‘Only the very best fresh beef suet from the caul and kidneys is used at this establishment, and of this there is bought and used daily about 600 lb., which is procured fresh every morning from the slaughterer. This fat is first mechanically cut up by means of a machine, which rapidly reduces it to a pulp, so finely ground that it resembles thick cream in consistency. It is then placed in open tanks of sheet iron holding 700 lb. each, which are heated by steam. This thoroughly dissolves out all the oily matter from the cellular tissue, the fatty matter floating on top being drawn or skimmed off carefully and allowed to cool in large vessels. By slow cooling the fat crystallizes, and the more solid margarin and stearin are separated from the olein, which remains diffused through the mass. The semi-solid mass is then put into strong bags of new cotton cloth, the variety known as “Pequot A” being used for this purpose. These bags, which hold about two pounds each, are then placed in a powerful press, which separates the lighter oil, forming the essential principle of butter, from the stearin, which is the harder and heavier product. As it flows from the press the oil is clear, yellow in colour, tasteless, and without odour, having been so refined in the several manipulations that all smell or taste of suet is entirely removed from the oil. The residue in the bags, which is stearin, is sold to be used for hardening lard sent to the Southern market and warm climates.’

“This yellow, tasteless, odourless oil is what is used in the skim-milk for making the so-called oleomargarine cheese, and when prepared as above stated, there is no reason why it is not as clean and as wholesome as the butter fat which comes from the udder of the cow. The most scrupulous neatness is observed in its production, the greatest care being taken to use only the freshest and best suet to be obtained from healthy fat animals slaughtered for beef. Indeed, old, tainted, refuse grease cannot be successfully employed, and if such were used the oleomargarine business would soon come to an end.

“The oleomargarine cheese is said to be a good-flavoured meaty article, having remarkable keeping qualities, and retaining its flavour much longer than the whole-milk cheese. The method of improving skim-milk by the use of oleomargarine is so effective that it is believed a considerable quantity of the new kind of cheese will be constantly thrown on the American markets from the creameries.”

In commenting upon it, “Moore’s Rural New Yorker” says:—



“From all we have been able to learn concerning oleomargarine, we have seen nothing as yet that would seem to prove that it is unclean or unwholesome; and as a further proof of our confidence that this is so, we may add that for several months past we have been using freely oleomargarine cheese on our table, and find it not only very palatable but wholesome. We believe that all foods, however, should be sold under their proper name, and so of oleomargarine cheese; and while there may be nothing in the flavour or texture to distinguish it from other cheese, it is just and proper that the consumer should know what he is buying, and thus, if he have prejudices against any particular kind of food, he may have full liberty to avoid it.”

It is none the less true that the reputation of American cheese in England has suffered most seriously on account of this imitation article, and that the loss inflicted on American dairy farmers in this way is incalculable. It has been rumoured that oleomargarine cheese has been made in a factory in one of the southern counties of England. If the rumour be true we may venture to hope that the practice will be discontinued, or else English cheese will suffer, as American has done, in that popular form of reputation which makes the sale.

From a report on the dairying industry of the United States, which was circulated at the Paris Exhibition, 1889, we take the subjoined interesting details:—As regards external trade, statistics show that the quantity of butter exported is undergoing a constant and rapid decrease, amounting for the entire Union to as much as 62 per cent. in the six years, 1883 to 1888. This shows that the States are depending less and less upon foreign demand. Another significant fact is the almost complete suppression of oleomargarine. The trade in this substance was enormous at the time of the passing of the law against it in November, 1886, and it is largely due to the efforts of a commission appointed to ensure strict compliance with the law that the oleomargarine industry has been almost ruined in so short a time. Seven-eighths of all the dairy produce exported by the United States is from the State of New York. The total value of the dairy produce of the entire Union for 1888 was estimated at about 76,000,000*l.* sterling, whilst the total value of the dairy products sold upon the New York market during the same year was only 8½ millions sterling, or a ninth of the total produce. The development of the cheese industry of the United States dates virtually from the first establishment of butter factories rather less than thirty years ago. Most of those now existing are worked upon the co-operative system. The great bulk of the cheese is of the kind known as American Cheddar. This make is cylindrical, flat, from 45 lb. to 90 lb. in weight, about 18 or 19 inches in diameter, and 6 inches deep. There is also the Young America, which has the same shape as the Cheddar; but is so much smaller that it is possible to pack five Young Americas in a box which would only hold one American Cheddar. Fancy cheese is not made, save on a very limited scale; but Limburger, Stilton, Edam, Pineapple, Neufchâtel, Swiss, or cream cheeses are variously produced in different localities. The American ideal of a good dairy cow is an animal of

1,000 lb. live weight, producing 30 per cent. of her weight in butter, or half her entire weight in cheese, in a year. Jerseys, Guernseys, Ayrshires, and Holsteins are largely in favour.

The following details are taken from an article by Major Henry E. Alvord on differences in milk products (cheese and butter), which appeared in the report of the Connecticut Board of Agriculture for 1888 :—Premising that good cheese is made from whole milk, or that from which no part of the cream has been taken, and that in old times little else was thought of, it is pointed out that so many inferior kinds are now made that the term “full cream cheese” is given to the standard product of the first quality. The differences now to be discussed are not those incident to the processes which result in “skims” and “filled” cheese (lard or oil substituted for fat removed in cream), but relate to the variations occurring in the quantity and quality of full cream cheese made from an equal weight of whole milk from different breeds of cows. Inasmuch as in well-made cheese a very large proportion of the total solids of the milk is secured in the product—nearly all the casein and fat, though most of the sugar escapes in the whey—it follows that the milk which is richest in total solids will make the most cheese per cwt. of milk, and the general statement is true that milk best suited to butter is most profitable for cheese. The data regarding cheese made from the milk of pure-bred cows of different breeds are meagre, but the principle stated is borne out by experience with Jersey milk. The general average in good cheese-making districts is 10 lb. of cheese to every cwt. of milk; with milk from pure Jerseys, in large number, on the common factory plan, it has been found that the same weight of milk will give over 12 lb. of cheese. At several recent shows in Canada milk from selected cows of different breeds has been tested with regard to its available curd, or cheese-making qualities, and although the animals have been few in number, an enumeration of the general results is not without interest. The order of merit as cheese-makers came as follow :—First trial—Jerseys, Shorthorns, Ayrshires, Guernseys, Devons, Galloways, Holsteins, Polled Aberdeens. Second trial—Jerseys, Ayrshires, Shorthorns, Holsteins. Third trial—Jerseys, Ayrshires, Devons. In the second trial the Ayrshires led in the quantity of curd without fat, but with curd and fat together took second place.

Little information, indeed, is obtainable as to the merits of different breeds of cattle as regards the quantity of cheese made from their milk, although it appears to be a fact that cheese made from the milk of Jersey cows is so much richer in both casein (proteids) and fat, that it is worth a cent a pound more than the average full-cream cheese of America, as an article of nutritious food. Upon this point it is interesting to recall the words of the late Professor L. B. Arnold :—“The business of the Jersey cow is emphatically that of butter-making. Her milk, however, is rich in cheese-matter, and, contrary to the general belief, is capable of making as fine cheese as it does butter. It is a new feature, worthy of note in the uses of this breed of cattle, that their milk can, without the waste of its buttery matter, be

converted into a strictly fancy cheese, as rich as English Stilton. Analyses of cheese from pure Jersey milk have shown over 40 per cent. of fat." The table here given—taken from the Connecticut report—affords information as to the extent to which different kinds of cheese may vary in composition.

TABLE OF ANALYSES OF DIFFERENT KINDS OF CHEESE.

Description of Cheese, 100 lb.	Water, lb.	Fat, lb.	Protein, or Curd, lb.	Ash, lb.
1. Average of 83 samples, full cream cheese.	35.75	30.43	27.16	4.13
2. Average of 21 samples, New York State Dairy Commissioner's Report	27.82	28.61	33.10	4.39
3. Full cream (Flint's Dairy Farming, of pure Jersey milk)	38.46	31.86	25.87	8.81
4. Full cream, Premium at New York State Fair	28.37	31.28	36.52	3.83
5. Full cream, Premium at New York State Fair	28.62	29.90	37.66	3.82
6. Full cream, Premium at New York State Fair	33.75	28.95	33.70	3.60
7. Full cream	28.11	41.03	28.18	2.68
8. English average, Sir L. Playfair	38.78	25.30	31.02	4.90
9. English Cheddar, 2 years old, Prof. Johnston	36.04	30.40	28.98	4.58
10. English Double Gloucester, 1 year old, Sir L. Playfair	35.81	21.97	37.96	4.25
11. English North Wilts, 1 year old, Prof. Johnston	36.34	28.09	31.12	4.41
12. Half-skim, average of 8 English samples	46.82	20.54	27.62	3.05
13. Half-skim, New York State	38.35	19.93	38.48	3.25
14. Skim-milk, average of 9 English samples	48.02	8.41	32.65	4.12
15. Skim-milk, English, 1 year old	43.82	5.98	45.04	5.18
16. Whey cheese, average of 6 samples.	23.57	16.26	8.88	4.76

The subjoined analyses are given by Duclaux:—

ANALYSES OF CONTINENTAL CHEESE.

	Grana.	Dutch.	Gruyère.	Old Cantal.	Brie.
Water	32.56	35.37	36.00	36.26	53.95
Fat	21.75	24.72	29.29	34.70	24.60
Casein, insoluble	22.12	25.69	26.51	23.18	12.44
"    soluble ( <i>see</i> p. 278)	18.50	8.43	4.33	1.41	4.85
Chloride of sodium	1.65	2.89	0.57	2.23	3.26
Other salts	3.42	2.90	3.30	2.22	0.90
	100.00	100.00	100.00	100.00	100.00

*Ripening of Cheese.*—Cheddar cheese will ripen in any time from three months to a year or more, according to the conditions of its manufacture. The rule is that a cheese which takes long to ripen will, if well made, keep a long time; a quicker-ripening cheese will not

keep good so long. A firm of Scottish cheese-makers, writing to us on this subject, say, "We always, when we wish cheese quickly into the market, make it rather acid. The sweet-made cheese takes longer to ripen, and is often as of fine a flavour when matured." A fine Cheddar, however, will keep well for a couple of years, though, perhaps, it was ripe in three months. What we want everywhere, indeed, is cheese early to ripen and slow to decay,—cheese that can be turned into money before it has lost more than 10 per cent. of its weight in drying, or that will keep well, if necessary, till a market is found for it. A temperature of 70° F., there or thereabout, has been found to ripen Cheddar cheese admirably, but it seldom happens that the atmosphere of the cheese-room is strictly maintained at that point, nor indeed is it necessary that it should be.

It is a good practice to place thin white paper upon the shelves on which the cheeses are laid, because when new they sometimes adhere to the board, and communicate a dampness to it that is prejudicial. The paper also promotes drying. At a more advanced stage the cheese may be laid upon straw, but at first this would sink into and deface the surface.

In a paper upon "The Ripening of Cheese: its Nature and Control," by Dr. Bernard Dyer, ("Journal of the Bath and West of England Society, 1891,") it is pointed out that taints in butter are generally produced by changes brought about by microscopically minute organisms or ferments, and that the main point to be kept in view in butter-making is to render as powerless or inert as possible the organisms with which we cannot keep milk and butter from becoming contaminated. Dr. Dyer proceeds:—

"In cheese-making the case is altogether different. There we are altogether dependent upon organisms, for the ripening of cheese is effected wholly by organisms or living ferments of various kinds—some of them bacteria, some of them moulds. The flavour and texture of cheese are determined by the particular organisms present, and the facilities afforded to one race or another to become dominant. It is the variety of the organisms, and the variation of the conditions in which they are placed, that account for the many kinds of cheese that can be made from one and the same raw material, milk.

"Not unfrequently we hear the special quality of the cheese of a given district attributed to special excellence in the local pasture. This notion (in the opinion of many) is not well founded. It is far more likely to be due in most cases to the special local prevalence of certain varieties of organized ferments. This view is supported by sound facts. It was formerly held that many foreign fancy cheeses could only be made in their native homes, attempts to imitate them elsewhere, even when the various steps of the process were carefully followed, having failed; the characteristic ripenings required did not take place—and the characteristic moulds were not developed. It has, however, been found that if the moulds are transplanted from one dairy to another, and the proper conditions are then observed, the characteristic ripening required *does* take place, simultaneously with

the growth of the characteristic moulds. Every one knows the difficulty of starting Stilton cheese-making in a dairy in which it has not been made before, and which is not in a Stilton district. The process of manipulation may be properly learned, and faithfully imitated, and yet the desired flavour is not obtained. The cheese may be rich and good, but it is not 'real Stilton.' Instances, however, can be now pointed to in which after previous failure the would-be Stilton-maker has succeeded by adopting the scientific process of inoculating his curd with fragments of well-ripened Stilton cheese of first rate quality from a good Stilton dairy, with the ultimate result that the necessary organisms have been acclimatised in their new home, and the making of Stilton has become a pronounced success. The very atmosphere of an old dairy is probably thronged with the germs of the organisms, that have long been at work, hourly and daily, and yearly, in its ripening-room. Many of these organisms have been individually studied by biologists abroad, though little scientific work has been directed to them here, and the sum total of the knowledge yet gained about them is very small. But the mere discovery of the principle that specific ripening is caused by specific organisms working under specific conditions, apart from a knowledge of individual species themselves, has already produced such practical results as these.

"The recognition of the fact that we depend on micro-organisms for the conversion of curd into cheese, and of the further fact that the culture of these organisms is greatly under our own control, at once imparts to the empirical processes of cheese-making an interest which to the intelligent dairy farmer they never previously possessed. It throws a new light upon his operations, and awakens observations and a desire for experiment in a far more systematic fashion than was formerly possible, and it is probable that in another half century practical cheese-making will be as much controlled by scientific principles as is already the case in brewing, a process in which the study of micro-organisms and their effect has assumed a great regulating influence.

"To illustrate how close is the correspondence between science and practice in some methods of cheese-making, we may briefly compare two different methods practised in Cheshire, viz., the production of old-fashioned late-ripening cheese, and that of the more modern early-ripening cheese. We will then see how the results arrived at in practice correspond with those which we should theoretically expect to happen from what is known of the general properties of organized ferments and of their work in producing organic changes more or less rapid—for the ripening of cheese is, as already said, essentially a series of organic changes wrought by living organisms. In a dairy in which old-fashioned late-ripening cheese is made, the greatest care is taken to strain and rapidly cool the evening milk, to keep it cool all night, and even to keep it covered till morning. The rennet is so proportioned as to produce a curd that will separate cleanly and firmly from the whey, very little acidity is allowed to develop, and

the greatest possible care is taken to remove as thoroughly as possible the whey from the curd.

“In making early-ripening cheese—we are considering, for contrast’s sake, the case of very early cheese, such as ripens off in a few weeks (and it may be added rots if it is kept long after it is “ripe”), the milk of the evening is not cooled, and no special care is taken to shield it during the night from the air. By no means is the same jealous care taken in getting a clean firm curd, as is taken with late-ripening cheese; acidity is allowed to develop freely, and the separation of the whey is not effected with anything like the same perfection—indeed much that might be removed is allowed to remain.

“What should we, scientifically speaking, expect to follow, in each case? Milk, before it reaches the cheese tub, is already largely infected by organisms from the dust of the air, like everything else that is exposed. If it is cooled down at once and kept cool, these organisms are kept in check, and increase and multiply but slowly. But if the milk be left with its natural heat in it, to cool down spontaneously, its average temperature during the night will be far higher, and such as to favour the growth and multiplication of the organisms in it—the rate of whose increase under such conditions is enormously great. Furthermore, if it is at the same time freely exposed to the dust of the air, it is all night receiving a fresh access of germs. The consequence is that when the milk is “set” in the morning, the curd thrown down in the one case contains but few organisms, while in the other it contains probably many thousand times more. Each of these organisms that is entangled in the curd may be regarded as a starting-point for change or fermentation. Consequently it is easy to understand that this one difference of cooling or not cooling the night’s milk may in itself be expected to enormously influence the rapidity of the ‘ripening’ process. Then, again, curd freed from whey is far less fermentable than curd containing it. It is the milk-sugar of the whey that in itself mainly nourishes many milk ferments, such as the lactic ferment, and probably many more. By leaving the whey longer in contact with the curd and allowing it to sour, we breed a greater crop of these organisms than if we run it off quickly. And if, in addition, we drain and press the curd but imperfectly, we not only introduce into the cheese more organisms, but we give them more pabulum to feed on. In the one case we have a cheese composed as nearly as we can make it of curd and fat only with but little whey; in the other we have more whey left in, and consequently more milk-sugar and soluble saline matters,—so that the whole mass to be ripened is not the same. We should not expect, therefore, the ripening process to be the same, apart from mere speed. And it is not. The fine flavour of old cheese is never developed in the extremely fast-ripening cheese we are now speaking of. Before the special and more delicate organisms that would give this flavour have time to do their work, the ground is occupied by the, so to speak, ranker and coarser organisms that by strength of numbers and of congenial food at once assume the mastery. A sort of parallel

is found in the grass-field. If we sow on a good old pasture coarse rank-growing grasses they soon crowd out the finer and less vigorous grasses and overrun the field. Even if we do not sow rank grasses, but merely manure an old/mixed pasture with heavy dressings of rich manure, like nitrate of soda, we know that the coarser and stronger grasses will be so encouraged as to gradually crowd out the clovers and finer grasses. So, doubtless, it is with cheese—reading organisms for grasses, and whey and its constituents for manure.

“When cheeses of intermediate ripening speed are made, it is by observing (or neglecting) such precautions as have been mentioned in an intermediate degree.

“The hastening of cheese-ripening within moderate limits—doubtless a desirable thing in the eyes of many farmers—was arrived at gradually, but of course empirically, and as the result more or less of accident followed by shrewd observation. Had the nature of cheese-ripening, however, been earlier understood, the manufacture of early ripening cheese might have been devised long before. As it is, the knowledge now possessed, limited though it is, enables the control of cheese-making to be effected far more intelligently than was possible before biology began to throw light upon the many interesting phenomena involved in it.”

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## CHAPTER VII.

### ON THE PRODUCE OF A DAIRY.

THE produce of a dairy is to be regarded in a twofold view, as concerning *quantity* and *value*. Both depend in a great degree upon management; for if the cow is injudiciously treated, or the butter and cheese are badly made, both the product and the price will be materially diminished. There is no part of farming which should be more steadily profitable than the dairy, but, at the same time, not one which demands greater judgment and attention.

Of the three objects of the dairy, namely, milk-selling, cheese- and butter-making, and the raising of young stock direct from the udder, the first is generally the most profitable at the usual price obtained for the milk. The milk-trade, however, can only be carried on within easy reach of a town or a railway, and in recent years the trade has been a good deal cut up by numerous competitors, too many farmers having gone into the business. Prices, therefore, have been depressed, as a general rule, during the time when cheese and butter have been low in value. Still, it is true that milk-selling pays as well or better than anything else in farming, and the hope is that it will

improve now that almost all the milk-producing districts have been tapped by railways. Well selected and well managed herds of cows will yield annually from 500 to 700 gallons per cow, and occasionally more, and this even at the low price of 6d. per gallon net will afford remuneration, small though it be. In the course of a paper read before the British Dairy Farmers' Association, on October 7, 1885, "On the necessity for some change in the law in regard to the adulteration of milk," Sir John Bennet Lawes, of Rothamsted, commented on the then somewhat unsatisfactory state of the milk trade in London :—

"It is not merely that the producer receives a very low price for the milk he supplies, for in this he merely shares the fate of all those who obtain their living from the products of the dairy, but because the law which makes it a punishable offence to sell milk that has been adulterated—or what in most cases is milk diluted with water—does not recognise, as a fact, that the quality of the milk from some breeds of cows is so high, that even if it were mixed with a considerable amount of water, it might still be richer than genuine milk, which was the product of other cows fed on a lower description of food. The result is, that the law in regard to the sale of milk, unintentionally gives every encouragement to the sale, not of *pure* unadulterated milk, but of *poor* unadulterated milk.

"It is quite evident that, under such a system, many breeds of cows which produce a high quality of milk, are altogether excluded from the dairy of the farmer, in consequence of his not being able to get a higher price on account of its better quality, while he cannot afford to sell it at the same price as the ordinary milk. As a matter of fact the production of the largest quantity of genuine poor milk is the great secret of success in such a state of affairs.

"At Rothamsted they had been investigating several questions with regard to the production of milk. Now suppose it was found that by a certain combination of foods, a milk of an unusually low percentage of solids could be obtained: would not this be hailed by the milk-selling farmers as a far greater boon than any process by which a much higher percentage could be produced? It may possibly be said such a milk would not be saleable, but this is quite a mistake. It is true the dealers might raise some objection, as although they will not pay for high class milk according to its value, still they like to have it: the public, however, would buy the low percentage milk readily enough. It does not further follow that the milk of poor quality would taste poor: they had lately shown that milk from silage, which from its colour and taste appeared richer than the milk from mangel, was not so rich in reality; and it is a well-known fact that the purest sugars are not those that taste the sweetest. At all events, without anticipating what may be in store in the future, it must be admitted that the principle of offering a premium for the cow which produces the largest quantity of poor milk is one which requires some modification.

"It is quite evident that the weak spot of the present arrangement is the want of some standard or basis on which the trade shall be regulated.



To say that a person shall be punished for selling adulterated milk, and then to leave the definition of what is, and what is not, pure milk to experts and magistrates—who possibly may differ considerably in their views upon the subject—is hardly fair to the producer. It is, however, much more easy to point out the objections to the present system than to suggest a remedy. Assuming it is desirable that a standard should be fixed defining what is pure milk—the question then arises, What is the standard to be? If it were fixed very low, so as to include the poorest milk ever produced, the result would be that all milk would be diluted down to that standard. If on the other hand a high standard were fixed, it would necessarily exclude some very poor, but yet genuine milk.

“Let it be assumed that a certain quality of milk was agreed upon, by producers and experts, as a fair average to represent genuine milk, and that this was declared to be the standard. The result would be that those who were so inclined would be enabled to keep cows yielding a very high quality of milk, as it would no longer be an offence to dilute such milk to the fixed standard. On the other hand, why should not other qualities of milk be sold, provided the seller stated the amount of dilution to which they were subject?”

“Another part of the milk trade which required some reform was the large cost incurred in the distribution of the milk, which affects it seriously as a cheap food. The sky blue liquid which used to be sold in London had no pretensions to be called a food, but genuine milk—were it not for the cost of distribution—would be a very cheap food, especially for the young, and although milk is not so well adapted as meat to be the food of grown up people, it is a perfect food for children, and at the same time very much cheaper than meat.

“Supposing the police regulations would admit of such a proceeding, if milk instead of being sent up to its destination in churns, could be conveyed by rail in a tank upon wheels, it might be sold direct to the consumers with very little addition to the cost of production, and it would thus become a staple article of food to the poor. If the demand for milk is to keep pace with the increased supply some such process must be adopted, and the producer and the consumer must be brought together without the intervention of the middle man. Mayfair and Belgravia may still continue to receive their daily supply through the middle man, if such be their wish, but the time is come when an effort should be made to furnish the teeming population of the Metropolis with cheap milk as a portion of their daily sustenance.”

The important subject here discussed by Sir John Lawes possesses an equal interest in the United States. There appear, indeed, to be fair grounds for asserting that the time is near when, in the States, all milk will be closely graded when it reaches the market, and every lot sold on its merits, the basis being the total solids. As a matter of fact, this process is already in operation in the discriminating market of Philadelphia, where Mr. G. Abbott adopted it some years ago. In buying milk he makes three grades: milk from registered Jersey and registered Guernsey herds he denominates grade A; that from herds of

Jersey and Guernsey grades is B milk; the product of herds of native or mixed blood is D milk. The A milk must yield not less than 14.50 per cent. of total solids, B milk must give not less than 13.50, and D milk not less than 12.50 per cent. of solids. Mr. Abbott pays  $\frac{1}{2}$  cent above the market price of D milk for B milk, and  $1\frac{1}{2}$  cents more for A milk. The A and B grades are sold at a corresponding advance in price. Sales of the D grade are confined to wholesale transactions. In supplying milk to retail customers two or three grades in price are as many as can be managed, and the dealer cannot well make more grades in buying than in selling. Mr. Abbott takes milk from upwards of fifty persons, and makes four or five analyses of the milk of each dairy per month. Shippers are urged so to mix their entire milkings that the contents of all their cans will be alike; they use mainly the 40-quart cans, and, as a rule, samples are taken from not more than one can of a shipment. One competent person is constantly engaged in making analyses—not a general chemist, but one specially trained for this work at the Philadelphia College of Pharmacy. The highest total solids ever recorded from the milk of a herd for a single day was 17.12 per cent. from registered Jerseys, and the lowest 11.32 per cent. from common cows. From herds of common or mixed breeds the following yearly averages of total solids were obtained in 1886—12.60, 12.66, 13.19, and 13.25 per cent. Mr. Abbott believes this system stimulates the production of better milk, and he would not know how to manage his business without grading; he adds that amongst dealers the disposition is increasing to test and grade milk and make a distinction in price according to merit.

The only ways of enlarging the margin of profit to producers of any commodity are to lessen the cost of production and to increase the selling price; to the producer the former is more likely than the latter to be available. The most direct method of reducing the cost of making milk is improvement in the quality of dairy cattle, and what many districts need to produce is not more milk but better milk. In view of the incontrovertible evidence of the influence of breed, much more than feed, upon the quality of milk, producers are exhorted to aim at supplying the top of the market. "Make the market, if need be. Grade your milk. Separate your milk, and encourage the trade in cream."

The making of cheese and butter ranks next in the scale of profit, provided a good article of either is produced. A well-fed cow, of a good breed, will produce, on an average, 200 to 300 lb. of butter in the season; and this, where there is an immediate market for it, together with the value of the skim-milk, either for feeding pigs or raising calves, will pay better than cheese alone. The common calculation is 150 lb.; but that has regard to mixed stock, which affords no certain data.

Mr. Aiton's calculation is, 250 lb. per annum, or 1 lb. of butter from every 10 quarts of milk; but that is for the best milkers of a very superior stock. Although it may be difficult to reach that quantity in any other than a very select dairy, there can be little doubt that, with proper attention to breed and feeding, the Epping average may be maintained.

The average product of *full-milk cheese* or whole-milk cheese in the best English dairies, where the whole milk and cream are used, cannot be estimated at more than four cwt. In Leicestershire and on other deep grazing soils that carry heavy stock, a well-managed cow is reckoned to make from three to five cwt.,<sup>1</sup> besides supporting her calf until it can be weaned; but such cows require fully three acres of the best meadow land, for summer and winter keep, and it is not in the power of every farmer, even if he has the stock, to procure such land to maintain them. In Somersetshire the average is four cwt. and a half;<sup>2</sup> in Essex not so high;<sup>3</sup> and Mr. Marshall states that of all the Midland Counties at something more than three cwt.<sup>4</sup>

The cows of Wiltshire are reckoned to yield from three and a half cwt. to four cwt. of cheese in the year, besides a pound of whey butter per week during the summer season.<sup>5</sup>

*Suckling*—that is, fattening calves for the butcher—is generally considered the least profitable, as well as the most precarious division of dairy farming, both from the accidents to which calves are liable, and from the more variable price of veal than of butter and cheese. It is, however, the least troublesome; and probably, from the making of butter being combined with it, would be the most advantageous. Supposing a steady weekly demand for butter throughout the year, the most advisable plan might be to keep such a number of cows as would supply that demand during the winter; and in summer, when butter is cheap and veal in request, to apply the extra milk to suckling calves, either for the market or for stock, as may best suit the ulterior views of the farmer. This must, however, depend on the situation of the farm; for that may not always afford an opportunity for the purchase of a succession of calves for suckling, or a market for them when fat; or it may not be adapted for the rearing of stock; and, in such cases, the best application of the skim-milk is either to feed pigs or to raise calves. The usual time required for fattening calves for the butcher has been already stated to be from ten to twelve weeks:<sup>6</sup> perhaps it would be less in summer, when the milk is abundant and the atmosphere genial and warm; but as the calf does not require the entire milk of the cow for some weeks after its birth, she will, for a short period, support two; and two cows, calving at different periods, may be calculated to fatten seven calves in the course of the year.

Compared with *grazing*, every branch of dairy husbandry should be profitable; but the trouble and difficulty of management exceeds the mere feeding of cattle for the shambles. Dairying has also this superiority in other points of considerable importance on farms where the mixed system of tillage and grazing is adopted—it does not require so rich a soil as that for fattening beasts, and it produces food for pigs,

<sup>1</sup> "Leicester Agricultural Survey," pp. 154 and 227. "Cheshire" ditto, p. 271.

<sup>2</sup> "Somerset Agricultural Survey," 3rd edit. p. 251.

<sup>3</sup> "Essex Agricultural Survey," vol. ii. p. 271.

<sup>4</sup> "Rural Economy of the Midland Counties," 2nd edit. vol. i. p. 326.

<sup>5</sup> Report of 'The Times' Commissioners."

<sup>6</sup> See Book i. chap. vii.

or calves, and thus, by nourishing more animals, creates additional manure and a profitable consumption of the crops on the spot. It has been calculated that the herbage that will add 112 lb. to the weight of an ox will enable a dairy cow to yield 450 gallons of milk, which will be found to exceed the return in meat, after making every fair allowance for the additional expense of management.

Throughout the system of dairy management the vigilant eye of the master should be carefully employed, for the servants will rarely give that minute attention to every particular which is so indispensably necessary in order to ensure success. On this account, it is likely that a dairy-farm of a moderate size—one, for instance, that keeps from ten to twenty cows—will, *if properly managed*, afford a larger proportionate profit than another of greater extent, because, in the former case, the farmer's wife and daughters can more easily superintend, or perhaps perform, a considerable part of the dairy operations themselves; and this will always be better done by them than by hired servants. No branch of husbandry deserves and requires such unremitting attention. Sir John Sinclair very justly remarks, "that if a few spoonfuls of milk are left in the udder of a cow at milking—if any one of the implements used in the dairy is allowed to be tainted by neglect—if the dairy-house is kept dirty or out of order—if the milk is either too hot or too cold at coagulating—if too much or too little rennet is put into the milk—if the whey is not speedily taken off—if too much or too little salt is applied—if the butter is too slowly or too hastily churned—or if other minute attentions are neglected—the milk will be in a great measure lost." If these nice operations occurred only once a month, or once a week, they might be easily guarded against; but, as they *require to be observed through every stage of the process, and almost every hour of the day*, the most vigilant attention must be kept up throughout the whole season. This is not to be expected from hired servants. The wives and daughters of farmers, therefore, having a greater interest in the concern, are more likely to bestow that constant, anxious, and unremitting attention to the dairy, without which it cannot be rendered productive.<sup>1</sup>

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## CHAPTER VIII.

### THE FACTORY SYSTEM OF DAIRYING—HOME AND FOREIGN.

IT will be not only interesting, but it will serve important practical purposes, if we glance, however briefly, at those methods in use in countries other than our own; and at the systems upon which dairy work is there conducted.

<sup>1</sup> Sir John Sinclair on the Husbandry of Scotland, vol. ii. p. 124.

Dairying in the United States of America has long been celebrated for the system with which its details have been carried out, even on farms which we should consider as very small—a system which embraces not merely the arrangement of the buildings, but the fitting up with various contrivances, and the application in working of different kinds of appliances; all calculated to economise time and save labour—both necessities of the situation in which American farmers find themselves, with respect to the difficulty of securing farm servants. As our readers are generally aware, the United States Government have a department which concerns itself wholly with agriculture. This department has done a vast deal of work since the date of its establishment, in the way of appointing commissions of practical men to inquire into various subjects exciting attention amongst, and likely to be of service to, farmers, publishing reports, &c. Convinced of the importance of attending to the production of butter and cheese—with a view to getting rid of the necessity of importing supplies of these from foreign countries—a commission was despatched many years ago to Europe, for the purpose of instituting inquiries in all the countries in which there were districts or localities celebrated for their dairy produce. The report published by the commission, which extended over a very wide range of countries and of districts, was perhaps the most valuable ever issued on any agricultural subject; and this, being widely and wisely distributed through the United States, gave an impetus to dairying which it has never since failed to feel the force of. It gave rise to the systematic working already alluded to, the latest and most successful phase or outcome of which is the “factory system,” of which doubtless the majority of our readers have heard, and of which there are now in this country a number of examples.

As usual in the case of all new movements, so in this; the proposal to establish the system met with great opposition. This was not to be wondered at when it came from quarters from which it might with some reason be expected to flow, where an interference with private enterprise was expected and feared; but that it should come from those who had not this excuse, if indeed any, to make, was a matter of surprise to some and disappointment to many. But to some minds all innovations are bad; and it is only when they become successes that they are considered in the more favourable light.

That the factory system is possessed of great advantages, even from a commercial point of view, a fair and candid review of all the circumstances connected with it will lead the majority of inquirers to admit; but that there are difficulties in the way of carrying it out in some districts, and that in a few it is not at all applicable, even its warmest supporters will readily allow. It would indeed be a singularly successful movement which was found to be applicable to all circumstances and all localities.

We cannot, from lack of space, give a full account of all the features connected with the system; nor, if space were at command, would that be necessary, as not coming within the scope of our work. We can only glance at its leading features,—those chiefly which involve points

of practical interest. That there will be many such points may readily be conceived; for, in such carefully conducted places as factories, in which every detail is carefully calculated and carried out, experience must have resulted in the deciding of hitherto disputed points of practice, or in the discovery of new ones. Every one at all desirous of excelling, no matter what the circumstances of his dairy, ought to be glad to avail himself of such results of a practice more extended, at all events, if not more carefully carried out, than his own. As that well-known authority, Mr. J. C. Morton, excellently well puts it: "Even on estates already well equipped, the practice of the best and most successful manufacturers ought not to be lightly thought of, either by the landowner or by the farmer." And when we learn that one result of the working of the factory system has been the raising of the market value of cheese—where cheese is the principal if not the only product made in the factories—ten shillings the cwt., as compared with home-made cheese in the same neighbourhood, one may well endorse the statement further made by Mr. Morton, "if the great staple agricultural manufacture of any country can be improved so as to largely increase the value of its annual produce—the fund out of which rent, labour, and the tenant are all paid—it must be pronounced mere sentimental folly to oppose the improvement because estates have been recently equipped at some cost for the former less profitable process."

This is putting the case fairly, candidly, and honestly; and any system which has produced such results should be welcomed by all as a new power adding to the wealth of the community. It is to be noticed, moreover, and that with no small degree of satisfaction by those interested in the progress of agriculture, that wherever a factory is established the *farming of the neighbourhood* begins to advance, and to rise in the scale of effective working. This, after all, is a natural result. It is an absolute necessity of the factory system that the milk supplied to it by the farmers of the neighbourhood shall be in the best possible condition; other than this will not do for the results they aim at; other than this, therefore, will not be bought. All milk sent to a factory must be clean and fresh, for the impure milk of one farm will vitiate the milk it is mixed with from all the others. The strictest care as to cleanliness is a *sine quâ non*—cleanliness of milk-pails, milk-cans, milk-sieves, and of everything from which harm may be apprehended. Instances of uncleanness have occurred, at times, at all the factories, and bad cheese has been the result. It follows, therefore, that the manager must keep a watchful eye on all the milk he takes in, so that disobedience to rules may be detected and punished.

In the American factories the practice, as may be supposed, varies considerably; still there is a general principle which runs through them all, so far as the working details, both commercial and farming or dairying are concerned. We do not consider that commercial details come so much within the scope of the present work as those connected with the practical making of butter and cheese, as from these the pro-

bability is that our readers may pick up some points of utility in their own practice, or may have suggestions thrown out to them. What we shall give, therefore, on the subject, will be confined merely to such. Those who wish to go fully into the matter will find it detailed in papers in vols. vii. and viii. of the Second Series of the Journal of the Royal Agricultural Society of England; in two papers read before the London Central Farmers' Club, the one by Mr. Henry M. Jenkins, and the other by Mr. John Coleman; together with the papers alluded to and named in other parts of the present chapter.

Taking the papers in the Journal of the Royal Agricultural Society, vol. vii., as our guide, we find the following is the routine of daily work, with a description of the arrangements of the buildings and appliances used. The cooling of the milk is the first and one of the most important parts of the operation. It is generally done by the aid of water obtained from wells or springs, yielding water of as low a temperature as possible. The methods in use for securing such supplies of course depend upon the local features of the springs or wells, and the relation of their level to that of the buildings. In one factory—and amongst the first erected—the springs were so situated that the vats were constructed in such a way as to enclose them. The excavations required were lined with solid masonry, and the depth of the vats, or "pools," as they are termed, was such that the level of the water in them was never higher than that of the floor of the spring-house. Racks were ranged near the bottom of the pools, on which the milk-cans or pails were placed, the water flowing through these racks and above them, to the height of seventeen inches.

Very few instances occur where a spring is available within a factory; and, indeed, a spring so located is not desirable, if only good and cold water can be obtained near to and brought down in pipes. In this way a fall is secured, so that the water has a force that is useful in several ways,—in washing floors and windows, in turning the wheel which actuates the milk-agitator through the night, and so on,—as well as in cooling the milk.

As soon as the evening's milk is received at the cheese factory it is weighed and run into the milk-vats, in which it is cooled and agitated until the morning's milk arrives, when both together are made into cheese. The water runs at the one end into the space between the two shells of the milk-vat, and out of it at the other.

In the case of butter-factories the milk is weighed and put into the milk-pails, which are made of tin, the depth being from 20 to 22 inches, diameter 8 inches. Two pails on the average are required for one cow's milk delivered. The milk is made to reach within four or five inches of the top of the pail, which is immediately placed on the rack in the water-pool, so that the level of water and that of milk are equal. Each pool is arranged to hold about 500 gallons of milk.

The cold water is kept passing through the pool in a continued stream, and if the temperature of the water be properly arranged, the milk should be cleared thoroughly from all animal heat in the space of about an hour. The most suitable temperature of the water is

about 50° Fahr. ; it should not be lower than 48° nor higher than 57°. As showing the diversity of practice—shall we say of opinion?—the ice process of cooling the water described in connection with the Swedish factories in a subsequent part of this chapter is not approved in the American system now under consideration, the butter made with ice-water being found to be, or supposed to be, more sensitive to heat than that made with cold spring-water.

It is considered of great importance to expose as little as possible of the surface of the milk to the air, in order that the top of the cream may not get dry, this dryness "flecking" the butter, and injuring its flavour. The milk of one day is left in the pools till next morning, giving 24 hours for the morning delivery, and 12 hours for the evening delivery, for the cream to rise. A little funnel-shaped vessel, with a long handle fixed to one side, is used to raise the cream from the pails. As soon as the blue milk level is reached no more cream is taken out.

The cream in autumn and spring is churned sweet as soon as it is taken out of the pails ; in summer it is put into pails and kept in the pools till it has acquired a slightly acid taste, when it is churned. In some factories the cream, as a rule, is churned sourish, the butter-milk going to the cheese-vats with the skim-milk, to be made into "skim-milk cheese."

The churning is generally done by steam power, and the churn preferred in American butter-factories is the Blanchard Churn, as seen in Fig. 72, which is made in different sizes to churn from 30 to 150 gallons. Quick churning, to which we have in another place referred, is not desired, as butter when churned too quickly is injured. A period of from half to three-quarters of an hour is considered the best. The quantity put into the churn at a time is from 60 to 70 quarts, and, with this quantity of cream, from 12 to 16 quarts of water, to dilute and thin the cream and to bring it to a temperature of about 60° F.

Some makers prefer to pass the cream through a sieve—previously diluting it with water—before putting it into the churn. This is done in order to keep back any knotty particles, and to ensure a perfect uniformity in the thickness of the cream. This mode of working is deemed of great importance by some makers of the best qualities of butter, who also prefer thin cream got by putting the milk in deep vessels to the thick "seething cream," obtained by putting it up in shallow ones, which is not evenly churned. The dashers of the churns are arranged to go within an inch of the bottom of the downward stroke, and to rise above the cream in the upward stroke. The temperature of the cream during churning should not be above 60°, and if at the finish the butter-milk should exceed this, the butter will be injured both in flavour and colour. In cold weather the temperature of 62° is the best.

The working up of the butter after it is taken out of the churn is a most important process, much of the quality being dependent upon the way in which this is done. There are various methods of carrying out the process, some dairymaids preferring hand-working, and this used



to be the most general way adopted with us. Others prefer to use mechanical butter-workers, these being most highly esteemed in America. Some dairymaids have always warm and often hot, perspiring hands. In such cases there can be no doubt as to what should be done; they should never resort to the hand process. But where they have cool clean hands, it is quite possible that there is nothing which can surpass the delicate manipulative power of the hand working, after some experience is gained. Cold water of the purest quality is essential in washing the butter previous to working. In the American butter factories, they use, in some instances, a water sprinkler, which is simply a miniature watering-can with a fine rose which delivers the water to the butter in finely divided and numerous

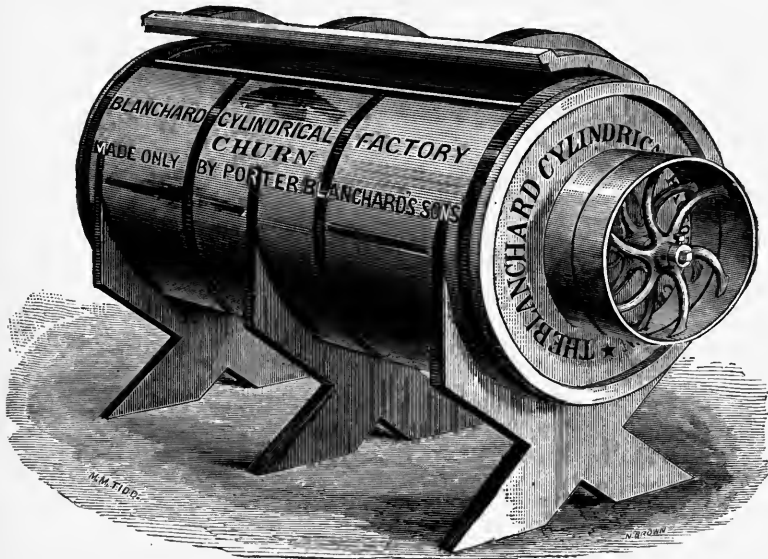


Fig. 72.—The Blanchard Churn.

streams. The points to be aimed at in butter-working are the thorough expelling of the butter-milk, and the giving to the butter “firmness of texture and a wax-like appearance when produced.”

The salting of the butter is a process which has to be done with care, in order to result in uniform flavour. Formerly, and indeed often now, butter is salted to such a degree that few people can eat it with pleasure; but a purer taste is gradually developing, and a mild saltiness is more frequently a favourite than formerly. With us far too little attention—in many cases it may be truly said none—is given to the quality of the salt used. In the American factories the greatest care is taken to have the purest salt; tests are applied to discover the presence of chloride of calcium—if discovered, the salt is discarded, as this substance gives a bitter taste to the butter. Sulphate and carbonate of calcium are also liable to occur. Higgins's

dairy salt is so prepared as to eliminate these foreign substances, and is specially suited for use in the dairy.

When the butter is removed from the churn, it is lifted with ladles into wood trays of an oval shape, and the butter-milk is rinsed out with cold water, the ladle being lightly used, so that the water comes off the butter-milk from one end of the tray. This gentle working with the ladle, and washing with the cold water, is repeated till the butter-milk is wholly washed out. The salt is now added—in the proportion of 18 oz. for 22 lb. of butter—and well worked in. It is then allowed to stand till evening—the above processes being of course part of the morning's work—when a second working is given to it, and it is packed for market. This proportion of salt is a high one, and for light salting 5 oz. would be enough for the quantity of butter named.

In the cheese factories, where the whole-milk process is carried out, *whey-butter* is sometimes made. Of course the quality of this is far below that of ordinary butter. Still, by the new process, it is very palatable; and, indeed, so good that, as is stated in the report, experienced dealers having the two kinds offered them without remark being made as to "which is which," the whey-butter has been chosen by them as the better of the two. Whey-butter, as a general rule, rapidly deteriorates, so that it is only fit for immediate use. Nevertheless, if all the water has been worked out, and if the product is potted so closely as to exclude all air, whey butter is found to improve by keeping for some months; a layer, one inch thick, of salt is placed on the top of the jar.

In the American factories the process of making whey-butter is as follows. A vat of copper is employed, 12 feet in length, 3 feet in width, and 20 inches in depth. This is set over an arched furnace, in which wood is the fuel used. The level of the vat and furnace is a little lower than that of the milk-vat, so that the whey can be easily drawn off from the latter. When the vat is filled to its proper height with the whey, "acid" whey is added to the mass in the proportion of 1 gallon to every 50 gallons of sweet whey. If the whey has itself an acid flavour, less "acid" is added in proportion; and if the "acid" itself be not sharp, 1 lb. of salt is added to the above quantity. As soon as the acid is added to the whey, heat is applied to the copper vat, till the temperature is raised to from 170° to 180° F. The cream begins to rise and is skimmed off with a tin scoop, and when wholly removed it is set aside in proper vessels till it cools, and is left to stand for about 24 hours. The cream, thus cooled, is then churned at a temperature of from 56° to 68°, according to that of the weather; and when the butter comes it is taken out and finished off in the usual way. About 20 lb. of butter are thus obtained, on an average, from 500 gallons of whey. The "acid" referred to is obtained by taking whey which is devoid of cream, heating it to the boiling point, and adding 1 gallon of whey which is thoroughly sour to every 10 gallons of boiling whey. The casein and albumin in the mass collect together and can be removed, and the residue is allowed to stand for 24 or 48 hours, according to circumstances, when it is fit to be used as the

“acid.” Singular to say, the whey left after the butter has been made from it is said to be better adapted for swine-feeding purposes than ordinary whey; this is owing to the sugar of milk being retained longer in the mass without change.

Having described the process of butter-making on the factory system, we shall now glance as briefly as may be at the details of cheese-making, taking as our “model” the example afforded by the Holms factory in Staffordshire which is fully described by Mr. Morton in the paper we have already quoted from, and named below.

We shall in the course of this chapter (page 360) describe the ice method of cooling milk for a butter-making factory, as employed in Sweden. We here describe the “cooling” system as adopted in the Holms factory, near Sheen, full particulars (supplied by Professor J. P. Sheldon) of the working of which will be found in a valuable paper (“Cheese-making in Home Dairies and Factories”) by Mr. J. C. Morton, in the *Journal of the Royal Agricultural Society of England*, vol. xi. second series (1875), page 261.

The cooling vats are of timber, having a milk-holding capacity of 500 gallons, the length of each vat being some 14 feet, width 4 feet, and depth 20 inches. Each vat is lined with tin, or rather has an interior tin vat, the dimensions of which are so much less than those of the main or timber vat, that a hollow space is left at the bottom and sides. The milk is placed in bulk within the tin vat, and cold water, passed into the jacket at one end, passes through the whole length of the space and out at the other. The evening’s milk, placed in the vats, is thus surrounded with cold water, and kept exposed to it all the night through. To prevent the cream from rising and also to aerate the milk, and to get rid further of any animal or other odour which may be present in it, wooden stirrers—which sink to a depth of two inches in the milk in the vats—are caused to move to and fro at regular intervals. The stirrers are moved by an ingenious arrangement. The issuing water from the vat, entering one of the buckets of a small water-wheel, fills this till it has weight sufficient to give the wheel half a revolution on its axis. By means of a crank and connecting rod, this motion is communicated to the stirrer.

The milk delivered in the evening, and thus set aside to cool, is reduced in temperature by, and generally before, morning to 60° or 65° F. The morning’s milk does not require to be passed through the same long cooling process, but is at once mixed with the evening’s milk. When mixed, steam is introduced under vat No. 1—the cold water having been of course previously withdrawn—and the temperature of the milk is raised to about 80° in the summer or warm weather, and 82° in the winter or cold weather. The rennet—which is proportioned to circumstances, but which if in proper condition should be at the rate of half a pint to every 100 gallons of milk—is then put into the vat, and well mixed; and the vats are next covered up with a cloth, to keep in the heat and maintain a uniform temperature. If the rennet is good, it should thicken the milk perceptibly in fifteen minutes, and thoroughly coagulate it in one hour.

Coagulation is completed when the curd will break cleanly over the finger; it is then cut by the curd-cutter, the cutting being done slowly from one end of the vat to the other, and repeated till the whole mass is cleanly cut, not bruised and broken. The curd thus cut is allowed to remain quiescent for a few minutes, till the whey rises and covers the surface, when the curd-cutter is again passed through the mass, but in a direction at right angles to the previous cut; thus leaving the curd in the form of cubical blocks, or rather parallelepipeds, say half an inch square on the side. The whey is then allowed to escape from the vat, and the curd slowly gravitates to the lower part of the vat. Allowed to remain quiet thus for a short time, the mass is gently turned over by the hands, and then it is cut into square blocks by the equally gentle use of a knife. These and all succeeding movements of the curd must be done with the utmost care—tenderness, as Mr. Morton well expresses it,—for it is essential to retain as much as possible of the fatty matter in the curd, and to allow the minimum only to pass off along with the whey. A little steam is now turned into the empty water space, and as soon as the temperature is slightly raised by it, the curd, acquiring more firmness, can be manipulated a trifle more freely, and turned about faster; this brings out the whey more quickly, and correspondingly reduces the bulk of the curd. More steam is turned on, and the curd is stirred more quickly than before, to prevent any over-heating of the mass at the bottom of the vat. The whey being by this time nearly wholly expelled from the curd, the latter has become hard and tough, and the curd-rake is freely used to keep its particles in motion. When a temperature of 90° F. is reached, the steam is turned off, and the curd is kept stirred till the bottom of the vat has gradually cooled. It is then allowed to remain quiescent for about ten minutes, when the steam is again turned on at full pressure, and the curd is kept in continual motion. When 100° F. is reached, the steam is for the last time turned off, and the curd kept worked till the vat has gradually cooled down.

The curd is now left till the “souring process” is completed, the time for effecting which is dependent upon circumstances, and is decided by the experience of the manager. A test sometimes employed is that of taking out a piece of curd and applying it to hot (not red-hot) iron; if it draws out into fine threads of about an inch long the curd is in good condition. Litmus paper, however, affords the safer test. The whey which has collected is run off from the vat by a syphon pipe; and still further to get rid of what remains, the curd is gathered up towards each side of the vat, till a space is left up the middle into which the whey runs. The whey, indeed, is run off before it has become acid, and the requisite acidity is developed in the curd alone, which is kept warm in the vat with that object. The curd, now adhering in a mass, is cut into pieces, and turned over and over till all the whey is expressed. It is then taken out of the vat, put into the curd-mill, and reduced to something like currants and raisins in size; to this salt is added—at the rate of 2 lb. to every 1,000 lb. of the milk, autumn-made cheese having a higher proportion of salt, about 2½ lb.

The salted curd is next vatted, and subjected to the action of screw presses till the last portion of whey is expressed. In these presses it remains till next morning, when it is taken out, and conveyed to the lower curing-room and weighed, has some tissue paper attached to the flat sides of what is now a formed cheese, and is placed on the cheese-shelves to cure and ripen. Here it is turned each day for a few days, when it goes to the upper curing-room, on the shelves of which it is turned every other day.

In some cases the curd is placed in what is technically termed a "dry-vat," so soon as the whey has been taken off it. This vat is generally a good deal smaller than those in which the milk is coagulated, and it is provided with a false perforated bottom, on which a cloth strainer is placed to facilitate the passing out of the whey.

The round form of the cheese, so well known, is obtained by using strong circular hoops of wood or of galvanized iron, the diameter being on the average 15 inches and the depth 5 or 6 inches. The hoops are placed on a movable board at the bottom of the press. The curd is filled into the hoop, and carries a cloth with it to the bottom of the hoop, the cloth being of course first placed over the hoop. When the hoop is filled with curd another cloth is placed over it, then a small board, and the whole is slipped under the press. The pressure is applied slightly at first, and then gradually increased till it reaches that of four tons. When the curd is solidified, it is ready to receive the permanent bandage, which is of stout calico. This bandage is so arranged that it covers the round edge of the cheese, with an overlay at top and bottom. The cheese is then returned to the hoop, and again subjected to pressure for about 18 to 24 hours, when the cheese is taken out and carried to the curing-room. In the factory in which the process now being described is carried on, the cheese, after being removed from the hoop, is rubbed over with whey-butter, for two or three days. This is done to prevent the cracking of the outer skin or rind of the cheese. The uniform temperature of the curing-room is of great importance; this for the first six weeks should be about 70° F., when it should be gradually reduced to about 65°, at which it should remain until the cheeses are sold.

In the American factories where the butter is made from sweet cream—not soured or lapped,—the skim-milk, being also sweet, is available for the making of skim-milk cheese, which forms part generally of the operations of butter-making factories. In making the skim-milk cheese, the milk is set in the vat at a temperature of 82° F., and sufficient rennet is added to coagulate the mass in 40 or 60 minutes. The process throughout is very similar to that we have above described. Here it is that the employment of animal fats found an opening, to supply the want of the cream removed,—hence we have that abomination of the dairy, oleomargarine cheese. This product is also called "filled" cheese, because after the removal from the milk of the natural butter-fat, the place of the latter is, as it were, "filled" up by another fat.

Butter factories have been established in Sweden with marked

success. As the farms are as a rule small, and the herds of cows kept equally so, the direct delivery of the milk to the company or factory is not available. We have alluded to this difficulty as existing in this country, and as being one urged by many farmers against the factory system. In Sweden, as also in America, at some of the factories this difficulty is got over by purchasing the cream only,—this is known as the “cream-gathering” system,—leaving the skim-milk in the farmer’s hands to be dealt with as his circumstances may dictate, as in the making of skim-milk cheese, the feeding of calves, pigs, &c. In order to facilitate the collection and disposal of the milk, even of the smallest farms, small “milk receiving houses” are erected at various points. These are fitted up with the appliances necessary to cool the milk, receive and retain the cream, with washing or scalding-room to cleanse the vessels—a cheese-making room if necessary—and accommodation for the dairymaid. “This system has,” says M. Juhlin-Dannfelt, in the “Journal of the Royal Agricultural Society of England,” vol. viii., second series (1872), “decidedly promoted the further development of the factory system, and at the same time opened the way to a useful and profitable branch of industry to those who occupy themselves with collecting pure milk from the smaller farmers, whose produce is too limited to allow the cream obtained from it to be treated in the manner which will make it saleable to the dairy company, or from such larger producers of milk as do not care to take the pains necessary for obtaining the cream, or for the further preparation of the skim-milk.”

The importance of cooling the milk as soon as possible after it comes from the cow is fully recognised by the Swedish companies, and means are furnished in each of the “milk receiving houses” for having this process carried out quickly and efficiently. A room is provided with a cold-water cistern, from which is drawn the supply necessary to fill the cooling vats in which the milk-pails are placed. If water cold enough is not obtainable, ice is used to reduce its temperature; and, indeed, so much more satisfactory are the results of ice-cooling, that it is now generally used.

As bearing upon various practical points connected with butter-making, &c., we here give a brief *résumé* of the facts detailed in the paper above alluded to. The ice used to cool the water in the supply cistern is broken into pieces some three or four inches square, as the cooling action is found much increased by this. The cooling vats in which the milk-pails are placed are about 9 feet long and 3 feet wide, with a depth of about 2 feet. A false grated bottom is provided to each cistern, and upon this the milk-pails are placed. A vat of the above dimensions is capable of cooling about 115 imperial gallons of milk. The pails were originally about 24 inches deep, and about 18 inches in diameter; but as it has been found that the quicker the milk is cooled the more completely is the cream separated from it, the size has been reduced to 20 inches in depth and about 9 inches in diameter, so that each holds about  $3\frac{1}{2}$  gallons. The depth of the iced water in the vats should be such that in summer time it is equal to the

height of the milk in the pails—that is the level of each should be coincident. The cream in this arrangement, as it rises, is kept cool; but in the winter season the level of the surface of milk in the pails should be above that of the water in the vat by some inches. The proportion of the ice used in cooling the water to the milk to be cooled varies, but on an average the quantities of each are about equal. By careful management the ice has been reduced to one-third; thus, in the Central Company at Stockholm, 1,500 cwt. of ice were used to cool the milk necessary to produce 2,500 cwt. of butter.

On the milk being delivered at the receiving houses, it is measured, and a small sample put into a graduated glass cylinder, which is left for cream setting, so that an idea may be obtained of its quality. The milk is then strained into the pails, and these are placed in the vats with about three inches interval between them. The temperature of the milk-room—the ice-water in the vats, and that of the milk itself—deciding the rising of the cream, the time taken by the latter varies. On an average the milk will be ready for skimming in about 10 to 12 hours, with a temperature of 35° of the ice-water, but more and better cream is got by allowing it to stand for 18 or 24 hours. The temperature of the milk-room should be as low as possible in summer, never below 50° in winter. The sooner the cream is churned the better, is the experience of the Swedish factories—or, as their reporter puts it, “the fresher and absolutely sweeter the cream is, the better will the butter be.” As we have seen from experience in this country, opinion differs on this. On arrival at the factory the cream is put into the ice-water vats at once to keep it cool and sweet. The average results of working may be stated thus: 2·65 gallons of milk yield 0·44, or nearly half a gallon of cream; this churned gives 0·93, or nearly one English pound of butter. The temperature of the cream found best for churning varies with the quality of the cream, the temperature of the churning-room, &c. There is one great advantage obtained by using iced-water in place of cold well-water—even if that can be obtained at a temperature sufficiently low,—and this is that while the well-water in the cooling vats requires to be constantly changed, the ice-water need not be changed oftener than a few times in the year. The surplus water from the melting of the ice is carried off by a small pipe, the orifice of which is near the upper edge of the vat.

The ice is not stored in a regularly-built house, but simply heaped up in a pyramidal form, in the open air generally, but sometimes in a shed, and covered with saw-dust, tanners' bark, or other good non-conducting material. Great care is taken to keep down the number and size of the spaces or interstices between the blocks of ice, and these where they exist are carefully filled up with sawdust. When ice is removed from the heap it is taken from the top, working downwards, and the spaces made by the removal are carefully filled up with sawdust. The lowest layer, or the bottom blocks, rest upon a layer of the non-conducting material at least a foot in depth.

The dairy factory system has made remarkable strides in Denmark, a circumstance that is chiefly due to the fact that a ready market was

found in England for Danish butter. In a paper on "Dairying in Denmark," which was published in the *Journal of the Royal Agricultural Society* (vol. xix., second series, 1883), Mr. H. M. Jenkins described the widely different details of the process of manufacture in the cases of fresh butter and keeping butter respectively. The former he terms a wet process, the latter a dry one. To make the best fresh butter hard pressing seems unnecessary, but to make the best keeping butter it is deemed to be essential. Whether, however, intended for immediate or for future consumption, butter is nearly always made in Denmark from

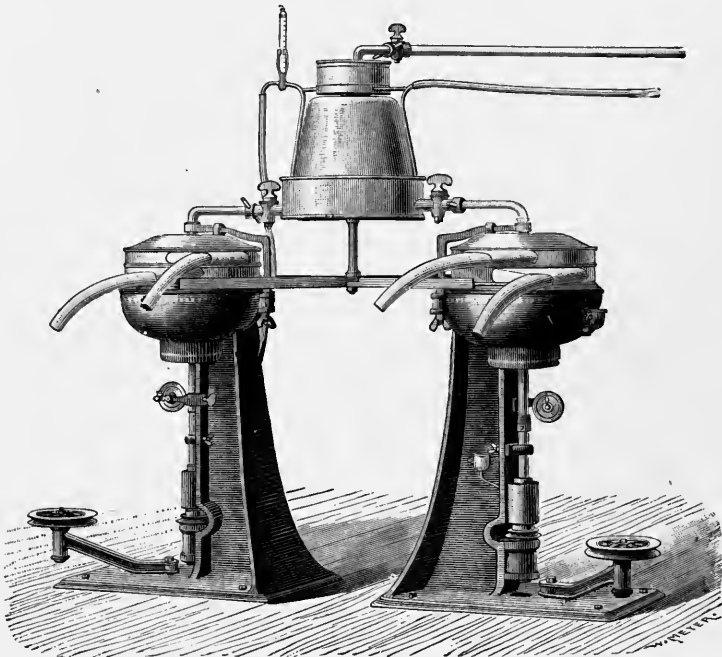


Fig. 73.—Two Laval Separators with Milk-Warmer in Action.

cream which has been taken from sweet milk, but which has afterwards been artificially soured.

Within recent years cheese- and butter-factories have multiplied in number pretty quickly in England, Scotland, and Ireland. When the factory system was first introduced, the chief reason why it did not spread rapidly was the expanding milk-trade of the day; now, however, the milk-trade is the chief reason why it is adopted, because the two are found to work well together. The factory is the receiving-house; and whatever milk there is, beyond the requirement of the trade for the day, is made into cheese, or butter, without loss or inconvenience. In 1870, the late Lord Vernon offered to put up a



cheese-factory for the use of his tenantry ; but they declined it because, being close to a railway, they were enabled to devote their energies to the milk-trade, which, in the form it has since assumed, was then a comparatively new thing. In 1884, the present Lord Vernon, who treads so well in his father's steps in agricultural reforms, erected a combined butter- and cheese-factory for the benefit of his tenantry, and others around, who had discovered that such an institution was needed not only for the manufacture of butter and cheese, one or both, as the case might be, but also to accommodate the vicissitudes of the milk-trade,

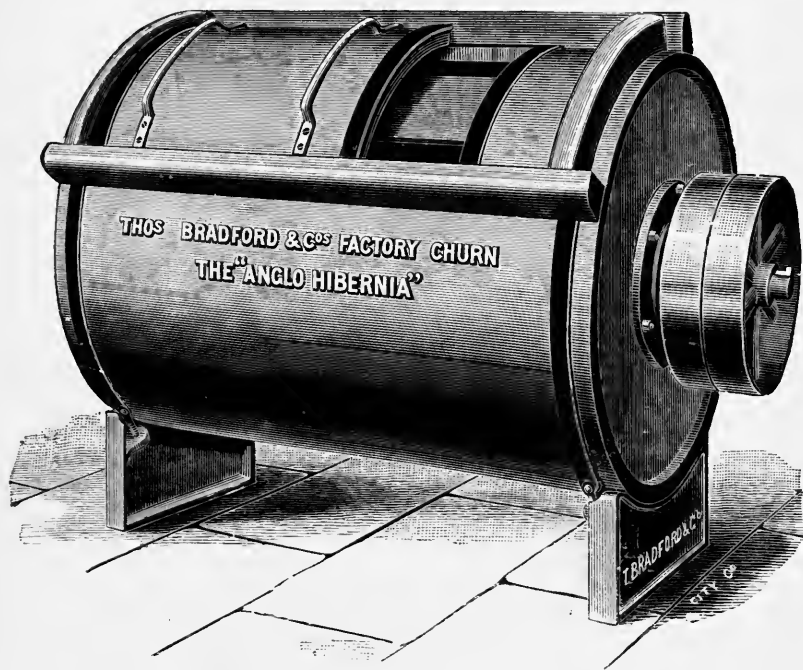


Fig. 74.—Steam-Power Factory Churn, the “Anglo-Hibernia.”

in which competition had by that time become very keen and general. The factory on Lord Vernon's estate at Sudbury, in Derbyshire, has had already a long career of gratifying success, and the Sudbury butter commands a high price,—far above the average for fresh butter. As we have said before, however, butter-factories are very differently conducted from what they were at first, for the centrifugal cream-separator has completely displaced the ice-water system of setting milk to cream, and indeed all other systems too. We have previously spoken of separators (p. 261), and have given illustrations of hand and power machines ; in Fig. 73 we give a woodcut of a machine for steam or water power—a double or twin machine, indeed, capable of separating 150 gallons

an hour, for which the Dairy Supply Company are the sole agents in this country.

By the aid of one or more separators, the milk is deprived of its cream shortly after arriving at the factory; the skim-milk is sold as far as possible, made into cheese, or fed to pigs and calves. The cream, being so greatly reduced in bulk as compared with the milk from which it was obtained, is easily taken care of until it is ripe enough to be churned. Fig. 74 affords a view of Bradford's Factory Churn, made in sizes to churn from 50 to 200 gallons of cream, yielding from 150 to 600 lb. of butter.

Where, on a large scale, as in a butter-factory, cream is obtained and churned by the aid of steam, it is obvious that a steam-power butter-worker will also be most appropriately employed. Indeed, where six

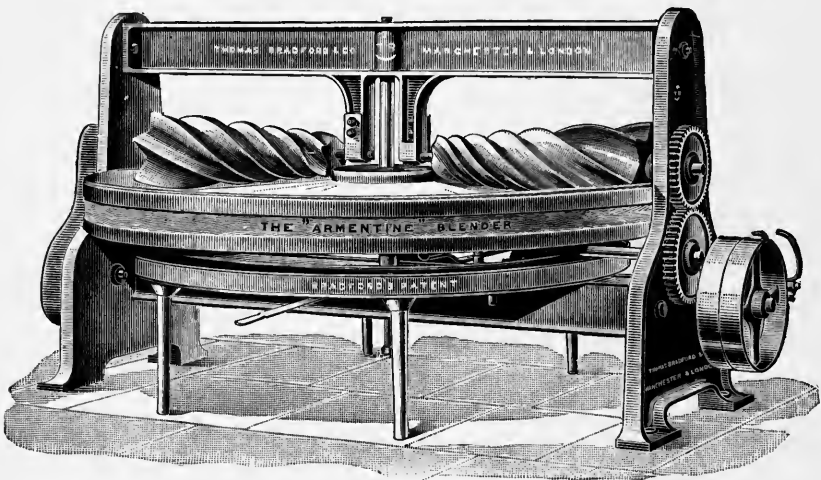


Fig. 75.—Butter-Worker and Blender.

or seven hundred pounds of butter are churned in one operation, a butter-worker of great capacity becomes a necessity, for to manipulate such masses of the golden product by hand-labour alone would be a task requiring a good many pairs of hands. The large machines suitable for butter-factories consist, as will be seen in the illustration, Fig. 75, of a circular table revolving horizontally, on which the butter is placed, and of fluted rollers, which, in a fixed position, manipulate all the butter successively, as the table revolves. The attendant turns up the fluted butter, so soon as it has passed under the rollers, and it is again and again flattened out, until the moisture has been extracted, the salt worked in, and the butter consolidated into a mass, firm and compact in texture. This machine is called a "blender," because it is most effectual in mixing together firkins of butter of different shades of colour, until it is of uniform character throughout. Fig. 76 affords the reader a view of a steam-power butter factory.

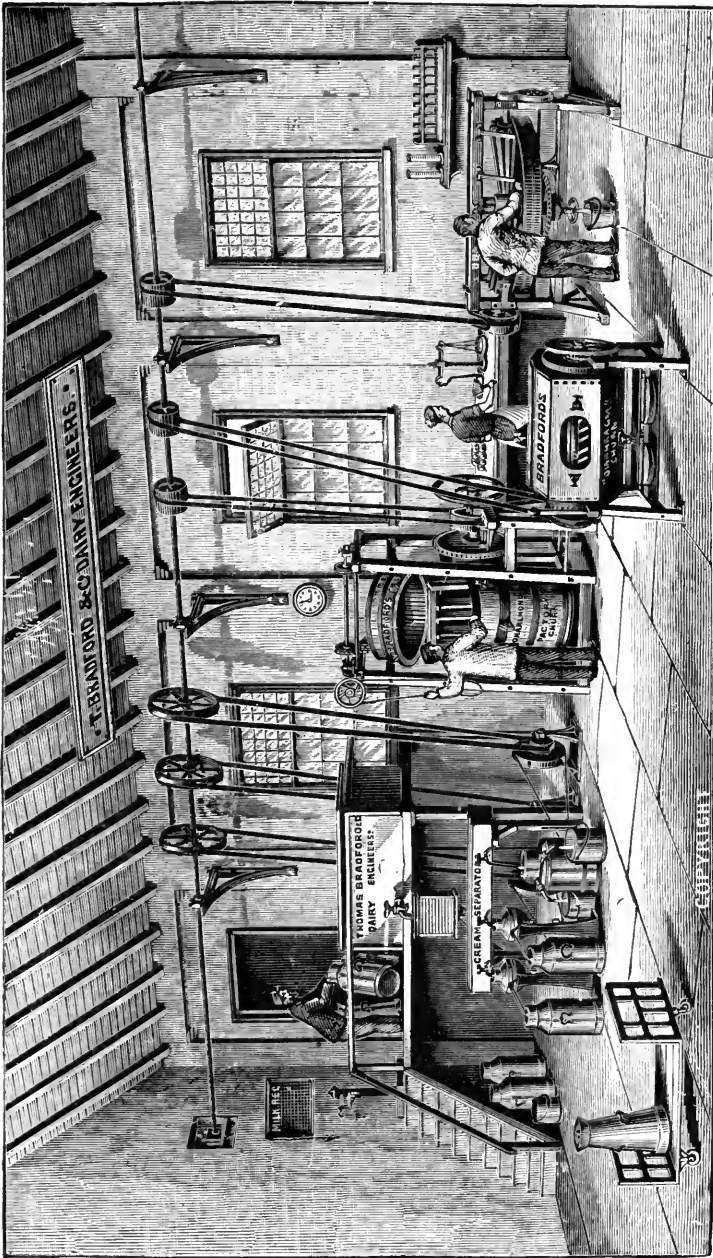


Fig. 76.—Plan of Steam-Power Butter Factory.

In America, and on the Continent of Europe, where the dairy factory or large farm dairy system is in vogue, *pig-keeping* generally forms part of it. To some, but perhaps not to the same, extent, this is the case in this country. The three products of the dairy useful for pig-feeding are whey, skim-milk, and butter-milk. In the neighbourhood of large towns, there is no difficulty in disposing of the two latter products.

But most cheese- and butter-factories are naturally situated in the rural districts, and for obvious reasons; and, being thus far from towns, the bye-products must be used near the farm or factory. Like many other agricultural questions, that of, Do pigs pay? is answered both affirmatively and negatively. In the paper by Mr. Morton, previously alluded to, the question of pig-feeding at dairies is freely discussed, and the discrepancy of opinion just noted is there exemplified; for while one farmer informed Mr. Morton that he would gladly give his whey away for nothing to anyone who would come to his dairy to take it, another valued it so much that he estimated that it was worth thirty-five shillings per cow a year to him; and another attaches so high a value to the whey, "that he justifies by its use the expenditure of 300*l.* a year for the purchase of feeding materials to be used along with it."

There is for the skim-milk a new outlet, when used for feeding purposes,—or rather we should say there are two new outlets,—first for the feeding of calves, secondly for the feeding or fattening of cattle, a recently-introduced system, but which seems to be more applicable to dairy cows, as it adds considerably to the yield of their milk. In the paper on Swedish butter factories, from which we have already culled some interesting facts on dairy management, there is a notice of the method of using the skim-milk for the feeding of calves, which lays before the reader some suggestive facts. From this notice it would appear that the use of skim-milk for this purpose has been eminently successful; the only drawback to it being that it gives a darkness to the flesh. This is, however, avoided by feeding the calves—when killed for veal—on sweet milk for the last fortnight before being killed. Separated milk—that which comes from the centrifugal separator—is profitably used in the making of bread.

Skim-milk, indeed, is valuable in a high degree for various kinds of animals, not calves and pigs and cows only, but horses too. For colts and fillies recently weaned, it is worthy of the highest possible recommendation in reference to the formation of bone and sinew, and to the steady growth of the animal in all respects.

The practice of giving much corn of any kind to young equine animals is known to be highly injudicious; but skim-milk is perfectly safe to use, for it will cause the animal to thrive well, and at the same time will do no harm whatever to the constitution, will form no humours, and develop no unsoundness.

## BOOK THE THIRD.

ON THE BREEDING, REARING, AND MANAGEMENT OF HORSES.

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### CHAPTER I.

INTRODUCTORY AND COMPARATIVE VIEW OF THE DIFFERENT BREEDS OF HORSES.

WE have no knowledge of the form and probable qualities of the primitive horse, except what we can gather from figures of him on the friezes of the ancient Egyptian and Grecian temples, and from some of the remains of Roman architecture. He seems to have been a strongly-formed, courageous, and noble animal; but, in the early periods of the world's history, he was used only in the chase and in war, and was never disgraced, as such use would then have been deemed, by the labours of commerce or of agriculture.

The wild horses of the present day are descended from those which had escaped from the tyranny of man, and wandered uncontrolled over desert regions in both the Old and New Worlds. Many of them retain evident traces of the noble blood from which they sprang. Generally speaking, they are easily subdued, and become the valuable, docile, and attached servants of man.

For an admirable account of the origin and early history of the most valuable of our domesticated quadrupeds, the reader may be referred to Professor W. H. Flower's article on "The Evolution of the Horse" in the Journal of the Royal Agricultural Society, vol. i., third series, 1890. From many points of view, observes the author, the horse is one of the most interesting of animals. In utility to man it yields to no other. It was his domestic companion, friend, and servant before the dawn of history. It has accompanied him in his wanderings over almost every part of the surface of the earth, performing duties, both in peace and war, which no other animal could have done, and giving man facilities for the exercise of dominion over nature which otherwise would have been impossible to him. The rôle of the ass, the ox, the camel, and the llama, in performing similar duties, has been of a limited and subsidiary nature compared

with that of the horse. It is only in very recent times that the progress of mechanical invention has begun to supersede some of the uses for which the strength and the speed of the horse for many thousands of years have alone been available. How far this incipient disestablishment of the horse from its unique position, as the main agent by which man and his possessions have been carried and drawn all over the face of the earth, will go, it is difficult to say at present.

In no country have the various qualities of the horse, in relation to the turf, the field, and the road, been brought to such perfection as in the British Isles. At the meeting of the Royal Agricultural Society of England, held at Newcastle in June, 1908, horses were arranged in the following sections:—Polo and Riding Pony, Cleveland Bay, Hackney, Hackney Pony, Shetland Pony, Highland or Fell Pony, Dales Pony, Shire, Clydesdale, Suffolk, Draught Horses, Hunters. This list may be taken to include the breeds or varieties of horses which are of agricultural interest, and which, therefore, should receive notice in this volume.

The most important event of recent years in connection with Thoroughbred Horses was the establishment of the Royal Commission on Horse Breeding in 1887. Through the Commission the money previously spent upon Queen's Plates is offered in the form of twenty-two "Queen's Premiums" of £200 each for thoroughbred stallions (three years old and upwards), on condition that each stallion winning a premium shall serve not less than fifty half-bred<sup>1</sup> mares, if required, during the current season, and shall stand or travel at the owner's option in the district for which he is exhibited, at a fee not exceeding forty shillings for each mare, and two shillings and sixpence to the groom. This work had previously engaged the attention of the Royal Agricultural Society, the first Spring Show of Thoroughbred Stallions having been held exclusively under the auspices of the Society at Newcastle-upon-Tyne in January, 1887, on which occasion there were 45 horses in the catalogue, competing (in the Society's northern district) for three premiums. The first joint Show of the Royal Commission and the Royal Agricultural Society, for the whole of England, was held in February, 1888, at Nottingham. In 1889, and again in 1890, 1891, and 1892, the joint Show was held at the Royal Agricultural Hall, Islington, in March, in conjunction with the shows of the Hunters' Improvement Society and the Hackney Horse Society, the whole forming the Annual (Spring) London Horse Show. Premiums for Hunter Mares are offered by the Hunters' Improvement Society, which may claim to have been first in the field in the improvement of hunter breeding. This society, indeed, inaugurated (in 1885) the premium system for thorough-bred stallions, before the matter was taken up by

<sup>1</sup> In a comprehensive paper, "Half-bred Horses for Field or Road: their Breeding and Management," by Earl Cathcart (Journal of the Royal Agricultural Society, Vol. XIX., s. s., 1883), the following passage occurs:—"It is only with a view to scientific accuracy that it is necessary to define the term Half-bred—which is not rendered literally. In the language of horsemen that term implies only some stain in the traceable pedigree hardly to be detected: in appearance and qualities a horse may be, to all intents and purposes, thoroughbred, yet, from some slight stain in the pedigree, unqualified for entry in the Stud-book."

the Royal Agricultural Society and the Royal Commission on Horse Breeding.

Our illustration of a Thoroughbred Horse (Fig. 77) is that of "Truefit" (by "Outfit," dam "Eleanora" by "Wild Dayrell"), the property of Mr. W. Burdett-Coutts, M.P. He was foaled in 1880, and the following description of him is given in the Hunters' Improvement Society's Volume III. (1889):—"His shoulders are grandly placed, and his back and quarters first-rate. He is exceptionally good in bone, his forelegs possessing  $8\frac{3}{4}$  inches of it below the knee, and in addition being wonderfully clean and flat. He shows plenty of muscle



Fig. 77.—Thoroughbred Stallion, "Truefit."

on his thighs. "Truefit," moreover, possesses that great desideratum in a stallion, plenty of heart room, as he has great depth of chest, and he is also a grand horse to meet or follow. One other great feature in this horse is that he is a splendid walker, a virtue that he transmits to his offspring to a remarkable extent, while he trots with that easy powerful swing which at once takes the eye of every hunting man."

**THE HUNTER.**—The report of the 1890 Show of the Hunters' Improvement Society, "established to promote the breeding of riding, driving, and military horses," contains a series of valuable notes by Mr. Charles Armstrong, in the course of which he defines the type from which to breed. He says:—

A class of horse greatly in demand at the present day is the sixteen-hand blood hunter, up to about 14 stone. He should be thick and strong on the back and loin, with long powerful quarters and muscular thighs, the sudden and repeated contraction of which will strain the

hocks and hind legs in quick paces long continued in the dirt unless the hocks be well-shaped, big-boned, and clean, and the hind legs be good, and measure not less than about  $9\frac{1}{2}$  inches round their smallest part.

Just as a large mill grinds more material than a small one, so a big-bodied horse eats and digests more food than a horse with a narrow waist, and is therefore enabled, in defiance of severe work, to maintain the thickness of his muscle, without which both strength and courage soon fail him. A horse or any other animal without a good constitution is by no means the servant of mankind, but is rather a pauper invalid on his hands, and no such horse or mare should ever be used for stud purposes. The scapula, or shoulder-blade, should be sloping, and the lower bone of the shoulder, or humerus, is all the better for being placed in a position as near perpendicularity as is possible to breed it. The neck should not be long, but the rider should sit a long way from the horse's ears and require long reins from hand to bit. The length of frontage should be in the shoulders rather than in the neck. The crest should be firm and muscular, with the head hanging at such medium height and angle as will enable the horse to bridle well, and go firmly up to the bit. The head should be long, lean, and blood-like; but the fulness of the eye, the playfulness of the ear, and the general cast and expression of countenance are more important than any particular or exact shape of the head. A small head often accompanies a small heart, and unless the latter, together with all blood-vessels, be large and efficient, the horse may do hacking or harness work, but he cannot be a first-flight hunter.

The arms should be full of muscle—the elbows turning neither in nor out—the knees strong and big, and the shank clear and hard as polished ivory, and measuring from 8 inches to  $8\frac{1}{2}$  inches. If less than 8 inches the horse may break down, if more than  $8\frac{1}{2}$  inches he will be slow and cumbrous. The feet should be neither too brittle nor too "fleshy," neither too small nor too big, neither too flat nor too perpendicular. They must hold a shoe during three weeks of much exercise, including four days' hunting; and above all, they must swing clear of opposite fetlocks and all other parts. A horse that "cuts" is at a serious disadvantage in work, and depreciation of value in the open market.

It matters little whether he be thoroughbred or nearly so, if he can gallop on without tiring in deep ground, and after his exertions drink his gruel, eat his digestible supper of hay and mash, and run out with free clean limbs next morning. All this list of qualifications is hereditary to a marked degree.

Manners are also hereditary, and so is every form of "temper" so called.

Colour is an important matter. Mahogany brown is as good as any. Then bay or chestnut; but greys and roans are not so saleable, and should not generally be produced.

As to the class of animal likely to become a profitable and successful hunting brood mare, Mr. Armstrong recommends:—



“She should be a good huntress herself, with constitution, limbs, and breeding. Her height should be between 15·3 and 16·1, and below knee she should tape not less than 8½ inches in the smallest part. Any fault or defect she has must be expected to show itself in her stock, because her influence is certainly not less than that of the sire. My own experience is that the mare has the greater influence, but I do not wish to press this view upon others. This mare is assumed to be well-bred, but not thoroughbred, and though carrying 14 stone in a quick run with hounds she can hold her own against all comers. A long, slow hunting run is no test of a horse; any underbred mare can stay



Fig. 78.—Hunter Mare, “Princess” (247).

out all day without galloping, and go home a long journey cheerfully, but she cannot gallop even twenty minutes in dirt at the pace of the modern foxhound on a good scent.

“Breed from the mare that gallops in dirt, stays through the run, goes home cheerfully, takes her turn regularly, and finishes the season a happy, healthy, robust, and practically sound huntress; then you will rarely suffer disappointment, and you may often get very valuable young cattle.

“During their hunting career big mares should not be summered at grass, as they are liable to take cold and make a noise, but smaller animals may go to grass without that danger.”

Fig. 78 is an illustration of “Princess” (247), a brown mare foaled in 1886, standing 15·3 hands high. She was bred by Mr. Charles Miles, and is by “Pero Gomez,” by “Beadsman” out of “Lavinia” (74). The Hunter’s Improvement Society’s Volume III., 1889, states:—“She is a big, wide, deep-bodied good mare, on short legs,

with plenty of quality, bone, and substance, is sound, and has good action."

**THE COACH HORSE.**—The *Cleveland Bay* is bred in various parts of Durham, Northumberland, and Yorkshire. The last-named county, and especially the North Riding, has been long famed for its superiority in breeding horses of every description. The prevailing breed is that adapted for the saddle or for the coach; but, in the district of Cleveland, whence, as well as from their common colour, the breed immediately under consideration derives its name, and in the Vale of Pickering, in the East Riding, they are taller and stouter than the others, more powerful, and better adapted for draught. They are, accordingly, much used in the North for agricultural purposes, and are there considered quicker in step, more handy, and in all respects more useful than the heavier cart-horse of the South, while they are also believed to consume less food.

In his work, "The North Countree," Mr. W. Scarth Dixon propounds the theory that the Cleveland Bay is descended from the admixture of Eastern blood, during the time of the Roman occupation of Britain, with the native mares; and the author further states that a legion of the Crespinian horse was stationed at Danum, the modern Doncaster, the members of which were mounted on horses obtained from Carthage.

The Cleveland Bays (Fig. 79) carry a fine coat, with black mane and tail, and although rather coarse-headed, they have a noble fore-hand, with a well-set shoulder and neck, a deep chest, and round barrel. Measuring from sixteen to seventeen hands in height, they have a stately appearance, and on this account were in much demand as coach-horses while the heavy family carriages of former days were in vogue. Good hunters for heavy weights were also formerly bred from the mares when covered by thoroughbred stallions; but, since fox-hounds have been trained to run at their present speed, and the barouche has been substituted for the coach, these have been condemned to the collar, and hunters are now only to be obtained from the second, or even the third, cross with the thoroughbred horse.

Mr. Lloyd states that the Cleveland should be possessed of good sloping shoulders, a short back, powerful loins, and long quarters. His head is plain rather than otherwise, and on the large side, but it is well carried, and his general appearance denotes activity and strength, combined in a manner not seen in any other breed. His action is not remarkably high, but it is the kind of action for getting over the ground. In colour he is bay,—either light or dark,<sup>1</sup>—with black legs, clear of hair. Black zebra-like stripes on the arm and above the hock are sometimes seen; these are known as the black points, and are supposed to denote special purity of breeding. White, save a small star, or a few white hairs on the heel, is not admissible, a blaze or white foot

<sup>1</sup> An erroneous idea prevails in some places that only the light golden bay is admissible. No greater mistake can exist, as many of the purest and best bred horses have been dark in colour.—*Cleveland Bay Stud Book*.

proclaiming at once the admixture of foreign blood. Adapted for the plough, a heavy conveyance, and slow saddle work, the Cleveland Bay is what the Americans term a "general utility" horse, and for artillery purposes his docility, strength, and endurance admirably qualify him.

The Cleveland Bay is better calculated for slow draught than for any other purpose. For rapid work, his carcass would be too heavy for his limbs, and he would be deficient in the elasticity requisite for quick action. When, however, he is not pressed, he will support a long continuance of fatigue, and has been known to travel the extraordinary distance of sixty or seventy miles within twenty-four hours, with heavy loads, three

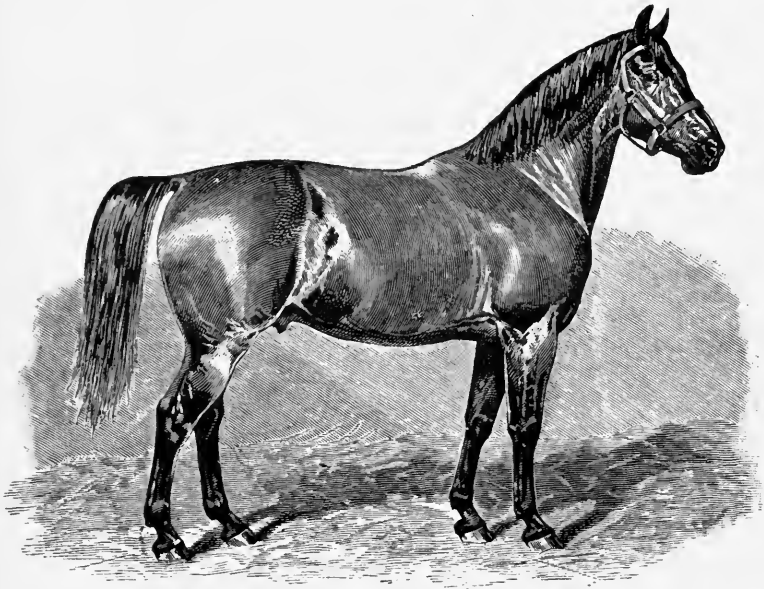


Fig. 79.—Cleveland Bay Stallion, "Freedom."

The property of Mr. Philip Charley, Belmont, New South Wales.

or even four times a week, besides being occasionally employed on the intermediate days.<sup>1</sup> There is, indeed, no better animal for farm labour; and the mares are the best species of stock for the double object of work and breeding.

It is right, however, to state, that this opinion is not shared in by some authorities, who look upon the Cleveland Bay rather as a carriage than a farm-horse. A dash of blood in a farm-horse is not to be despised; as remarked by Mr. Wilson, "One needs only to see how such horses get along at turnip-hoeing, or with a heavy load in a one-horse cart, to be convinced of their fitness for the general work of a farm."

The origin of the Cleveland Bay, or Chapman Horse, as it appears formerly to have been termed, is discussed by Mr. W. Scarth Dixon in

<sup>1</sup> See "The Agricultural Survey of Durham," p. 257.

the Cleveland Bay Stud Book (Vol. I., 1884). From 1851 to 1867 the breed was in a flourishing condition, but after the latter date the pure breed began gradually to decrease in numbers, partly on account of Clydesdale and Shire Horses coming more into favour, and partly on account of the heavy drain caused by a largely increased foreign trade. Heavy cart-horses, too, brought abnormal prices, owing to the rapid increase of mining operations, as well as of general trade throughout the north of England; and the suicidal policy of coupling Cleveland mares with carting sires was not infrequently adopted. Since the establishment of the Cleveland Bay Horse Society, interest in the breed has revived, and the volume of foreign trade has increased.

The great merit of the Cleveland Bay, is, according to Mr. G. Holmes, of Beverley, that he is not tainted with either Black or Blood—that is Black, or what is called Cart Horse, and Blood or Thoroughbred,—in fact it is a separate and distinct breed.<sup>1</sup>

There is, however, a mixed breed in other parts of Yorkshire, obtained by crosses with black and blood horses; but, for the general purposes of farming, they are not equal to the original stock.

The *Yorkshire Coach Horse* has, according to the Stud Book of the breed, been a source of great profit to the Yorkshire breeder, it being an animal that needs only to be seen to be admired,—to be used to be appreciated. Its breeding ground is almost exclusively confined to the North and East Ridings of Yorkshire. In the North Riding, especially in the Cleveland mining district, a big strong kind still exists, reared chiefly by the small farmers. These horses are admirably adapted to their purpose, for tillage and haulage, and occasionally, if the owner be of a sporting turn, for service in the hunting field. Nor has the more-favoured agricultural country of the East Riding failed to produce its quota, from the Driffield, Beverley, Howden, and Holderness districts. For generations have these horses and mares, of a superior style and character, been brought to meet the London and Continental

<sup>1</sup> That the Cleveland Bays have enthusiastic admirers is shown by the following lines from the "Whitby Gazette," March 29, 1879 :—

Where Cleveland Hills in vernal charms are seen,  
Clothed with the velvet of unfading green,  
The noblest stock of England's far-famed steeds  
With lavish care the thriving farmer breeds.  
By sires for fleetness, and for courage known,  
From mares for strength, and symmetry, and bone;  
Bred for power, and all unstained with white,  
Black-legged and bay, just as the ruby's bright.

All things that live have parallei, save one,  
The Cleveland Horse: he alone has none—  
Horse may with horse contend, the swift, the fleet,  
As noble rivals on the course may meet.  
Some for their shape, and symmetry, we prize,  
Others for strength surpassing—some for size,  
But in the noble Cleveland are combined  
All the rare qualities that grace his kind,  
Beauty in his strength, courage and wind, and speed,  
And more than all, he claims a stainless breed.

dealers who resort to the September fair at the quaint little town of Howden.

Though the Yorkshire Coach Horse has long been recognized as a distinct class, it is probable that few if any of them have been kept free from all infusion of Arab blood. It cannot therefore be claimed for him that he is a pure bred animal, but that, on the contrary, by the judicious crossing of large-sized good-coloured mares with stallions altogether or nearly thoroughbred, a class of horse has been produced suited to the wants and circumstances of the times. Certain characteristics have been carefully cultivated. The colour should be bay or brown with black legs; mane and tail abundant, but not curly; in height from 16 hands to 16 hands 2 inches, with fine head, sloping shoulders, strong loins, and lengthy quarters, high-stepping action, good sound feet, flat legs, and plenty of bone and muscle for any effort that may be required of them (see Figs. 80 and 81).

Remarkable as are the produce of common county or shire mares when mated with thoroughbreds for strength and even sometimes for appearance, says Mr. Wm. Hutchinson in the "Live Stock Journal," the staying power of the produce of the Yorkshire coaching mare mated with the thoroughbred is infinitely superior, as are also the intelligent head, straight rounded back, and lengthy quarters of the latter to the thick jowl, low shoulders, narrow loins, and drooping quarters too often seen in the former. If there is anything in hereditary disposition and qualities, what can the breeder of, so-called, half-bred horses for either saddle or harness purposes want better for his foundation than mares in whose veins still runs the blood of Escape, Sandbach, Ruler, Old Screventon, and Necromancer, strengthened by mating with real coach horses such as Pierson's Peato, and Pulleine's King William, the one trotting eighteen miles within the hour, and the other one mile in three minutes on the Leeds turnpike-road, and that not with perambulators at their heels and the most attenuated of stable-boys holding the reins, but carrying on their backs eighteen and fourteen stone respectively?

Mr. George E. Brown, Aurora, Illinois, writing in the "Live Stock Journal Almanac" on Cleveland Bays and Yorkshire Coach-horses in the United States, says: "For a time we feared that the controversy, resulting in two societies and registers in England, might have a detrimental effect in America, but fortunately it has not so proved, the Cleveland Bay and Yorkshire Coach Horse being recognised here as one and the same, and of equal value, both having proved themselves sufficiently prepotent to impress their characteristics on foreign breeds with remarkable certainty. I have often remarked that, in respect of the power of transmission, they are only equalled by the Devon and Holstein cattle, whose blood once infused, descends through many generations, showing distinguished features. The American trade in these horses is yet in its infancy. Having been uniformly successful, the demand for them has rapidly increased; and as our newly-settled States become improved, and the settlers better circumstanced, they will require better horses. The Cleveland Bay makes an excellent

farm and general-purpose horse, and when old enough for market finds ready sale at high prices. The demand for them is not confined to one or a few localities, but comes from all parts of the United States."

With reference to the two classes under notice, the following remarks taken from Mr. William A. Blew's report on the horses exhibited at the Windsor Show (1889) are of interest:—

"The Cleveland Bay is entitled to respect, for he has an individuality of his own. Scan a Cleveland Bay, or his near relation the Yorkshire Coach Horse, as narrowly as you please, and you will soon see that, in many material points, he bears no resemblance to the thoroughbred or

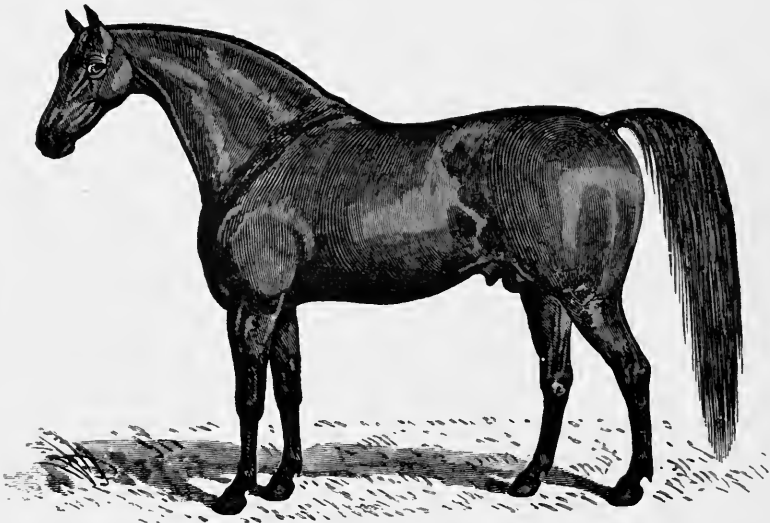


Fig. 80.—Yorkshire Coach Horse, "Lord Chancellor" (265).

hackney; and in looking over the coaching classes, shoulders, backs, loins, and quarters must not be regarded as though one were examining a hunter. It is further necessary to bear in mind that the Cleveland Bay's mission in life is not to trot a mile in three minutes in a buggy or dogcart, but to comport himself with stateliness and dignity in the rarely seen Cee-spring chariot and the full-sized landau. I must not, however, be understood to even suggest that the Cleveland Bay has no pace, for the speed at which the Royal carriages invariably travel sufficiently proves the contrary; but his chief use is for harness work, where action, imposing appearance, and strength are required.

"A near relation of the Cleveland Bay is the Yorkshire Coach Horse, which, in spite of its Society, can scarcely be deemed a distinct breed, inasmuch as it is admitted that a strain of fresh blood is required every now and again to counteract the natural tendency to become leggy. The opinions of a Southerner are obviously of little worth, but I

confess to being unable to quite understand where Cleveland Bays and Yorkshire Coach Horses begin and end.

“The Cleveland Bays, in what I may call their aboriginal form, are agricultural horses, with plenty of grand points in their frame, but with no elegance of ‘turning,’ and without action, and therefore totally unfitted to produce, from themselves alone, the big carriage-horse. The Yorkshire Coach Horses have both the qualities above referred to, but they again, if kept to themselves, will in a short time become high in the leg and light of bone, and consequently equally unfitted to draw the weight of a big barouche or a state coach.

“Before dismissing the Cleveland Bays and Yorkshire Coach Horses

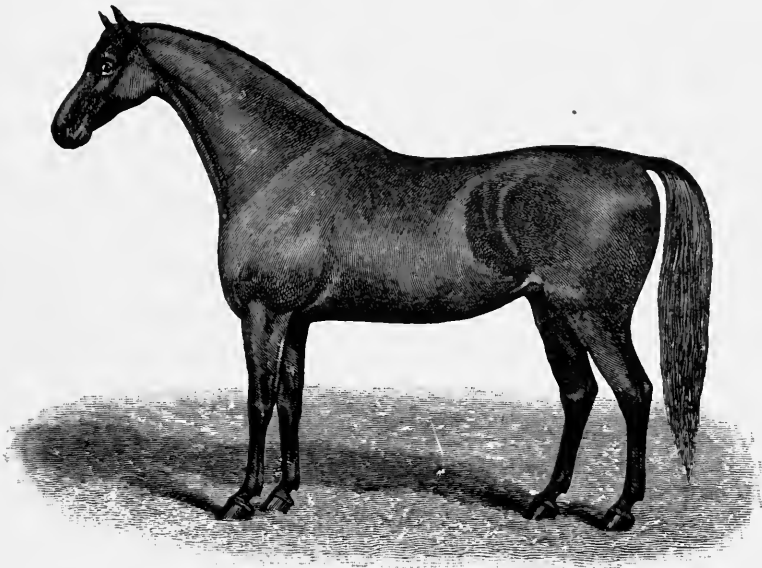


Fig. 81.—Yorkshire Coach Mare, “Lily.”

it is somewhat curious to note that nowhere, so far as I have been able to ascertain, is any mention made in coaching history of either of these breeds, not even in connection with the north roads. We find notices of blacks, greys, and chestnuts, which obviously could be no relations to the Cleveland Bay, and we are told of the thoroughbred, or nearly thoroughbred, teams which were employed on certain fast stages. But of the breeds under notice we hear nothing, which is certainly a curious circumstance, because one would think that the northern contractors would have largely made use of a breed which has always stood high in the affection of Yorkshiremen.”

**THE HACKNEY.**—The best and most complete account of the development of the modern Hackney Horse is that given by Mr. Henry F. Euren, in the Hackney Stud-Book (Vol. I., 1884). It appears that

in England the oldest surviving appellation for the active riding horse is that of Nag, derived from the Anglo-Saxon *Knegan*, to neigh. When the Normans became masters, they introduced their own more familiar term *Haquenée*, or *Hacquenée*, the French word derived from the Latin *equus*. This name had been fully adopted into the English tongue in the year 1303. Chaucer, who, it is believed, lived for a time in Norfolk, spells the word in two forms—as *hakeneý* and *hacknaye*. The old writers used it in the sense of a riding horse for general purposes, as distinct from the war horse. Both Nag and Hackney continue to be used as synonymous terms to this day. Possibly, the name Trotter,<sup>1</sup> descriptive of the characteristic gait of such a horse, had been used in the vulgar tongue long before we find record of it, for the action is most accurately described by a writer on English customs as early as the year 1170.

The origin of the modern type of Hackney is, says Mr. Euren, undoubtedly to be sought in one horse, variously known, more than a century ago, as the Schales Horse, Shields, or Shales (foaled about 1755), the sire of the better known Scot's or Schales Horse. The former was the first noteworthy trotting Hackney stallion of the modern type.

Mr. Anthony Hamond observes ("Live Stock Journal Almanac") that the Hackney, an established English Breed of determined character, is now coming to the front more than it has ever done before. Under the term Hackney is now included the Yorkshire Roadster and Norfolk Trotter, bred very much from the same stock, though the Yorkshire breeders have crossed more with thoroughbred blood than the other breeders in the eastern parts of England. Much care has been taken to preserve the breed in Yorkshire, Lincolnshire, Norfolk, Huntingdonshire, Cambridgeshire, especially the Isle of Ely, also in Suffolk, whilst many parts of England, Scotland, and Wales have found the horse with action, the Hackney, to cross well with their mares.

The Welsh cross is especially good, as can be seen by the numbers of Norfolk stallions with a dash of Welsh cob blood in the pedigrees.

The inclusion of these breeds under one term, Hackneys, and exhibition of them in the same classes, make judging at shows very difficult; some are riding horses, some driving horses. There are

<sup>1</sup> In Lawrence's "Philosophical and Practical Treatise on Horses," published in 1796, it is stated:—Horses, for the different purposes of the saddle, were in former days termed Nags, Amblers, Pacers, Stirrers, Trotting-Horses, Hobbies, Great Horses or Horses for the Buff-saddle (for war), Hunting-Horses, Coursers, Race-Horses. The appellatives, whether synonymous or distinctive, in present equestrian use among us, are Road-Horses, Riding-Horses, Saddle-Horses, Nags, Chapman's Horses, Hacks, Hackneys, Ladies' Horses or Pads, Hunters, Running Horses, Racers, Race-Horses, Gallopers, Welter-Horses, Managed Horses, Chargers, Troop-Horses, Post-Hacks or Post-Horses, Trotters, Cantering Hacks or Canterers, horses which carry double, Cobs, Galloways, Ponies, and Mountain-Merlins.

But the same writer states in his History that the (then) present varieties of the Horse, and their denominations, were as follows:—The Racer, Race-Horse, or Running-Horse; the Hunter; the Charger; the heavy and light Troop-Horse; the Hack, Hackney, Roadster, Road-Horse, or Chapman's Horse; a cloddy, compact Horse or Gelding of this description is now and then styled a *Coble* (hence our word "Cob" is modern); the Lady's Horse, or Pad; the Coach-Horse, Chariot, and Curricule Horse; Gig-Horse or Chaise-Horse; the Machiner and Post-Hack; the Cart and Dray-Horse, Galloways, Ponies.



exceptions, but as a rule the horse which goes fast in harness and keeps on going, if with weight and force enough to draw a fair sized cart round a show ring, the cart containing the usual two people instead of the driver only, would rarely be pleasant to ride out of a walk, having generally strong, if not rather heavy shoulders. Again, the pleasantest riding horse with fine shoulders can rarely go fast in harness.

The object of the majority of breeders, and the only way in which a small owner or tenant farmer can get any benefit from horses, is to breed an animal which is saleable at an early age, whose breaking is not attended with much risk, as is the case in breaking a young hunter for sale, and such as can be bred and reared at a moderate expense. To attain this, Mr. Hamond maintains that the Hackney breed is well suited. Much discussion has taken place about the size of the Hackney, many people holding the opinion that no Hackney is over 15 hands 2 inches. The Royal Agricultural Society of England also limited the Hackneys in their prize list to that height until their Show held at Norwich, 1885, when, at the request of the Hackney Stud Book Society, a class 15 hands 2 inches and over was allowed and well filled.

The thoroughbred horse has increased in average height about three inches in 150 years. In the same way the Hackney, which was no doubt formerly about fourteen hands, and even less, has, by selection of breeding animals, by care, and proper feeding of young stock, also increased in size, and this to the great advantage of breeders, especially of those who breed harness horses. A good little horse with action is worth money, a good big one is worth a great deal more, and very large sums are always given for match pairs. The Hackney stallion (Fig. 82) stands on short legs with excellent feet and joints, and is sounder perhaps all round than any other known breed in England. At the first show of Hackneys held in London (1885) at the Agricultural Hall, over twenty stallions, varying in age from four years to sixteen, selected by the judges, were absolutely sound.

As regards crossing, the same experienced breeder expresses the opinion that the cross between a thoroughbred sire and Hackney mare may be a valuable animal, but is oftener a nondescript weed; the produce of a Hackney sire and thoroughbred mare is a better one, as both the mare's stamina and the action of the sire are often acquired.

Some recommend a cross of the Arab, which would certainly give neatness; others, cart blood, to increase size, which no doubt it does; but why is it necessary, when such animals as those recorded in the Hackney Stud Books are to be obtained, to go outside and try experiments?

The more alike the sire and dam are to one another in form and character, the more certain is the produce to resemble its parents; and few breeds of animals have male and female so alike as the Hackney, especially among those of cob size.

A horse bred from Hackneys whose pedigrees can be traced back for years is certain to have action, and action always commands money.

The following description of a stallion, written by Richard Lawrence in 1816, is well illustrated by the modern champion, winner at three London Shows, viz., Reality, sire Confidence (D'Oyley's) 158:—

“The proper stallion for breeding road horses should be what is called half-bred, with a small head and well-turned neck issuing high out of his breast, shoulders deep and not too narrow at the upper part or withers, rather a broad chest, especially behind the elbow, long muscular arm and short shank. He should go light in hand, with great liberty in his shoulders, and the knee should be elevated and

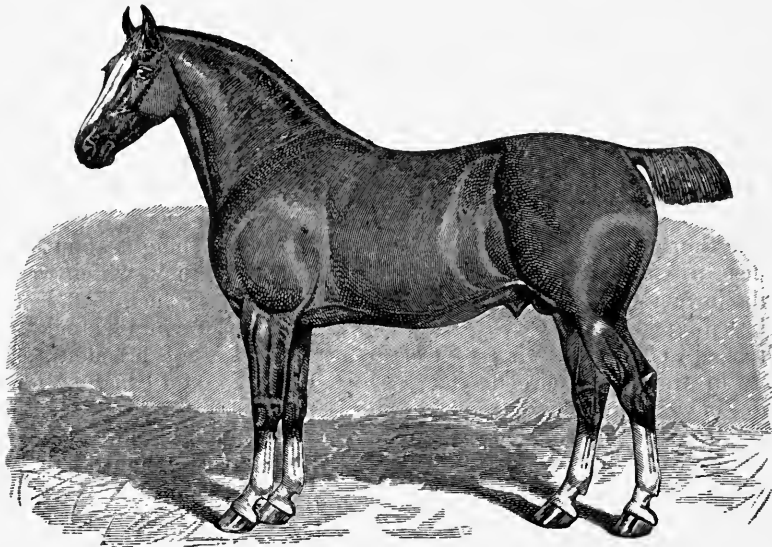


Fig. 82.—Hackney Stallion, “Evolution” (2058).

The Property of Mr. Harry Livesey, Rotherfield, Sussex.

advanced during the trot so as to be seen by the rider projecting beyond the breast. His back should be short and ribbed home, his girth large, his belly round. His hind quarters should be bold and muscular, and not too long in the thigh or leg.”

Given such a stallion as this and well-bred Hackney mares, the usual uncertainty of breeding would be reduced to a minimum.

**PONIES.**—The height of a pure-bred Shetland pony will range from  $8\frac{1}{2}$  to  $9\frac{1}{2}$  hands. He is, says the “Live Stock Journal,” often very handsome, with a small head, intelligent countenance, short neck, fine towards the throttle, back short, quarters expanded and powerful, legs flat and fine, and pretty round feet; ribs laid on until within about two inches of the hip bone, having great width and depth over the heart and lungs; shoulders well sloped, forearm and thighs strong

and muscular, and he may all over be said to be a miniature Clydesdale in shape (Fig. 83). He is to be found of all colours, but black and brown are most common. For hardiness, endurance, and docility, the Shetland ponies stand first in horse flesh. They live outside all the year round in a very trying climate, which is as changeable and variable in its temperature as in its winds. Their food is gathered off bleak hillsides, in winter supplemented by sea-weed and a "rip" from the owner's hand.

Mr. R. Brydon tells us that "these ponies were first used in the Durham coal pits in 1847, and for 'putting' purposes the superiority of Shetland ponies over other breeds soon asserted itself. They are more docile and manageable in the pit, more easily trained, much stronger, size for size, than the Welsh; not nearly so nervous, and become much sooner accustomed to the new circumstances in which they are placed. Many of these ponies do thirty miles per day, the weight of



Fig. 83.—Shetland Ponies.

The Property of Lords A. and L. Cecil.

the load, tilt and coals, being generally from 12 to 14 cwt." A record like this from so reliable a source makes it unnecessary to furnish further proof of endurance and capacity.

It is, however, as children's ponies that the native Shetlanders are *par excellence*. They are free from any vice, docile, sagacious, full of courage, and adapt themselves to the inexperience and frailty of their youthful riders to a degree that is simply surprising, and they present a very pleasing appearance in southern districts when harnessed to a light garden chair, or carrying a baby rider.

For sagacity and knowingsness the "Sheltie" is unsurpassed. Necessity is with him, as it is with ourselves, the mother of invention, and he very soon learns to open the barn door or gate-latch, provided it is not locked, and thus admits himself to the corn-bin in the winter, or the grass in the summer. In riding, too, amidst mist or snow on the open moors, on the homeward journey, the pony is the best guide if the rider is sufficiently acquainted with him to give him his own way.

When he encounters bogs or ice, he knows by simply sniffing at the surface if it can carry him safely across; and those who try to urge a pony when once he has refused these surfaces are very ill-advised, and repent of their action when they lie sprawling in the mud.

The pony cannot be accused of lack of courage, although he is cautious and judicious, as he does not hesitate to plunge into his native voes and swim many of them a mile wide, against in many cases rapid currents, for the purpose of joining the society of his kind, or for enjoying more succulent pasture.

Of the origin of the Welsh pony there is no trustworthy record. Mr. W. Lort states that the breed has existed for more than a century, and that from time to time it has received dashes of fresh blood from foreign horses wrecked on the coast of Wales. A few still exist of which the colours—mostly listed yellow duns and dirty greys—alone remain to indicate their origin; size is lost, and so are the lop ears and heavy foreign neck. On some of the hills far removed from the sea,—as in the pony counties of Radnor and Montgomery,—where little or no alien blood has crept in, the ponies are truer in type, although the characteristic drooping quarters, upright shoulders, and calf knees prevail, and are an appreciable set-off to the blood heads, full eyes, deep girth, and short legs usually met with in the Welsh pony. At the crucial test, “the show,” the Welsh pony of to-day almost invariably succumbs to the improved pony, the one that has in his veins the cross of the thoroughbred, and in his looks the carriage and make of the dwarf hunter.

One of the difficulties in the path of the pony breeder is to control size,—to compress into the least compass all the valuable qualities of the breed. The most valuable pony that any breeder can set himself the task of producing is, says Mr. C. W. Wilson, of Rigmaden Park, the ideal one possessing good shoulders, perfect and true action, good manners, and small head—an animal that can carry an elderly gentleman up to fifteen or sixteen stones weight, to whom the effort of mounting a big horse is a source of discomfort. This is the highest point in pony breeding, and it brings with it financial success, for such an animal never goes a-begging. Ponies are not subject to side-bone, ring-bone, or curb, nor to the thousand-and-one diseases and failings that afflict their big brothers.

A model pony fit for anything, and good for everything, should, according to Mr. J. E. Backhouse, have in shape a champion prize hunter's points, and in action should possess all the go and finish of a perfect-stepping hackney. “Whenever the realisation of such an ideal is found, cherish it as the apple of your eye, and never rest content until you have purchased or bred such another. But where and when shall we go to find such treasures of pony flesh is the necessary question, and we own that the answer cannot be very definite, for it is a case of seeking and searching without regard to time or labour. There are two distinct varieties of ponies.

“ (1) The town or lowland bred pony.

“ (2) The moor or hill pony.

“The first sort is doubtful as to blood, and generally runs lightish and flashy, useful as it may be and is.

“The second sort have purity of pony blood, but suffer, as a rule, in their shape to a fancier’s eye from tendencies to goose rumps, heavy fore-ends, lowness in withers, and upright forelegs; besides which they are often cramped and tied up all round in action, and are *bonâ fide* daisy cutters. But all the same it is to the moors and hills we should go in our search for ponies fit to breed from, as many a moor pony breeder has pedigree strains, and a good moor mare judiciously mated with a less hairy-legged sort may produce the real pea. Fields for search are practically unlimited. We have Exmoor, Dartmoor, New Forest, Wales, Westmoreland, Cumberland, Durham, the Yorkshire moors and dales and Scotch highlands, to say nothing of Shetland, if a small sort be required. We have found a cross between Welsh and Durham stock answer well, but as a rule it is best to stick to one breed, unless particular characteristics are objected to, but remember that each breed has its special character so strongly impressed that mares, however crossed, will very often throw back. To put a conclusion to the whole matter, never buy a pony for breeding purposes unless you are satisfied that it has purity of blood, as well as shape and action. Having completed your triangle of necessary qualities, go on and prosper; buy, breed, and win.”

POLO PONIES have come rapidly to the front within recent years. The Royal Agricultural Society of England provided classes for them, for the first time, at the Manchester Show in 1897, and these have been continued each year since. A Polo Pony Society has been established, with offices at 12, Hanover Square, London, W.

THE SHIRE HORSE.—“The most ancient breed in England” is a proud title for any variety of horse to possess, and in a charming book<sup>1</sup> it is applied to the Shire “whose gigantic proportions and magnificent symmetry are at once the surprise and admiration of all beholders.” Sir Walter Gilbey is led to the conclusion that the Shire Horse is the purest survival of an earlier type which was spoken of, by mediæval writers, as the Great Horse, and that if this horse did not originate in England yet this country at a very early date acquired a wide-spread reputation for producing it. The breeder will read with interest the following observations culled from the work:—

When Arthur Young—in the latter part of the last century—was describing his tours through the counties of England and Scotland, he mentions only two varieties of Cart Horses as deserving attention: the Large Black Old English Horse, “the produce principally of the *Shire* counties in the heart of England, and the sorrel-coloured Suffolk Punch, for which the sandy tract of country near Woodbridge is famous.”

<sup>1</sup> The Great Horse, or the War Horse: from the time of the Roman Invasion till its development into the Shire Horse. By Sir Walter Gilbey, Bart. Second edition. Vinton & Co. 1899.

At this date, 1796, in an article "Operations on British Horses," in the "Sporting Magazine" (Vol. IX.), it is stated: "We have a large and strong breed in the more fertile and luxuriant parts of the island; and there is no country can bring a parallel to the strength and size of our horses destined for the draught, as there are instances of single horses that are able to draw the weight of three tons."

Having regard to recent opinions as to the origin of the appellation "Shire," it is noteworthy that, in the statutes of Henry VIII., the name "Shire" is first mentioned (32, c. 13), in connection with horses; and that the breed, from that time, has been known by this title. This distinction of *Shire* Horse has been so universally accepted, that it does not seem desirable to attempt to change it. Whether by the name of the War Horse, the Great Horse, the Old English Black Horse, or the Shire Horse, the breed has for centuries, beyond a doubt, been distributed in numbers through the district between the Humber and the Cam; occupying the rich fen-lands of Lincolnshire and Cambridgeshire, and extending westward through the counties of Huntingdon, Northampton, Leicester, Nottingham, Derby, Warwick, and Stafford, on to the Severn. At the same time it should be said that it has been extensively bred in the low-lying pastures of England, in counties both northward and southward of these limits; everywhere retaining its typical character, though varying slightly with the soil, the climate, and the food.

The enormous bulk, the prodigious muscular strength, and—to conclude our quotation from Sir Walter Gilbey—the lamb-like docility of the true British draught-horse are especially impressive. The sight of fine teams, such as may be seen in any of our large cities, fills the mind with the notion that there is hardly anything, in the way of modifying size and form, which cannot be done by careful and prolonged attention to the science of breeding.

The formation of the Shire Horse Society (originally the Cart Horse Society) was first broached in 1877. Early in 1878, Mr. F. Street read a paper on "Cart Horses" before the Farmers' Club, and it was resolved to form an association "for the establishment of a Stud Book for Shire-bred horses." On this occasion Mr. Street enumerated the points of a Shire horse as follows:—"The feet should be firm, deep, and wide at heel, not too long or straight in pastern, flat bone, short between fetlock and knee. A stallion should not measure less than 11 inches below knee, and girth from 7 feet 9 inches to 8 feet 3 inches, should not stand more than 17 hands, should have wide chest, shoulders well thrown back, head big and masculine, without coarseness; full flowing mane, short back, large muscular development of the loin, long quarters, with tail well set on, good second thighs (this is a point where so many fail), large, flat, clean hock; plenty of long silky hair on legs; or, to sum up in a few words, a horse should be long, low, and wide, and thoroughly free from all hereditary disease. A main point in action: he should be a good mover in the cart horse pace, walking, and if required to trot should have action like a Norfolk cob." In the course of the year named

(1878) the Shire Horse Society was firmly established, its objects being:—(1.) To improve and promote the breeding of the *Shire* or old English breed of Cart horses, and be the means of distributing sound and healthy sires throughout the country. (2.) To promote the general interest of the breeders and owners of Shire or old English Cart horses.

In his introductory essay in the first volume of the American Shire-horse Stud Book, Mr. Alexander Galbraith, Janesville, the President of the Association, says:—

“The high state of perfection to which the English Shire-horse has attained is the natural result of many generations of careful, patient, and painstaking study in the science of breeding, and the present generation owe a lasting debt of gratitude to those early breeders and improvers of this noble race of draught horses. In the beginning of this century the principal, if not the only, colours of Shire-horses were blacks, dark browns, and greys. Now there are in addition, a great many chesnuts, sorrels, bays, and roans. The typical Shire-horse of the present day (figs. 84 and 85) weighs about 1,800 lb. to 2,000 lb., stands 16½ hands high, on short, strong, heavily-muscled legs, with an abundant supply of long hair on the back of the legs from knees and hocks to pasterns. His knees are broad, hocks clean and free from puffs or fleshiness, head medium size, wide between the eyes and very masculine—a slightly Roman nose is not considered objectionable, being generally indicative of force, but ‘dished’ or hollow faces are not liked. The eye is prominent and clear, expressive of vigour; the throat latch cleanly cut, neck moderately long and well arched on to the shoulders, which are deep and strong, and tolerably oblique. The chest is wide and full, denoting a strong constitution; back short and straight, ribs round and deep, coupling short, hind quarters long, level and well let down into the thighs, which are especially strong and well-muscled. The hind-legs from hocks to pasterns descend perpendicularly; the cannon bones should be flat, heavy, and clean, and the feet wide, tough, and prominent at heels. Action bold and straight. General characteristics: Immense strength, symmetrical proportions, bold free action, and a kind and tractable disposition. The effects of climate, soil, and feeding are very noticeable in Shire-horses, those raised in the fen-lands of Lincolnshire or Cambridgeshire having usually a greater amount of bone and hair than those from Yorkshire and Lancashire, although the latter counties have, in many cases, the credit of supplying horses of finer texture and greater endurance. The different types of Shire-horses observable at nearly all the large shows have given rise to much discussion and controversy of late, and, although every man is free to act according to his own taste, the generally accepted modern opinion is in favour of that type which combines quality and action with good, clean, heavy, flat bone, and hair of a soft, silky character. The old-fashioned cart horse, with fourteen inches of bone below the knee, short pasterns, gummy legs, and coarse, curly hair all round, has now few admirers, although a good many of this class can still be seen at the London

Spring Shows, and some of them, when crossed with clean-legged mares, have proved excellent breeders."

In previous editions of "The Complete Grazer" what is now termed the Shire was denominated the Black Cart Horse, respecting which the following interesting observations are retained:—

The *Black Cart-Horse par excellence*, the "Old English Black," is mostly bred in Leicester, Northampton, and Lincoln, and some of

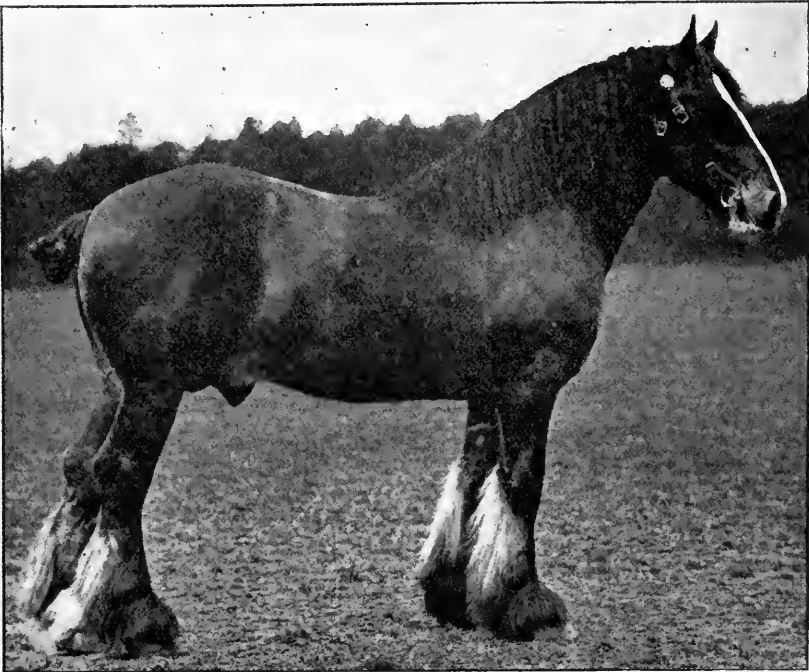


Fig. 84.—"Buscot Harold" (16,576), Champion Shire Stallion at London Shire Horse Shows, 1898 and 1899, and at R.A.S.'s Shows, 1898 and 1899.

The Property of Mr Alexander Henderson, M.P., Buscot Park, Faringdon, Berks.  
(From a photograph by Gambier Bolton, F.Z.S.)

the neighbouring counties; but the largest kind, and that principally used in brewers' drays and other heavy road-work, is chiefly reared in the fens of Lincolnshire. These counties have been from time immemorial in possession of a celebrated breed of black horses, from the lighter of which some of our heavy cavalry were formerly mounted.

An improvement upon the original stock is said to have been effected by the late Earl of Chesterfield, who, during his embassy at the Hague, sent over six Zetland mares to Bretby, his lordship's seat in Derbyshire, whence their descendants found their way into Leicestershire, and were further improved by an importation of West Friesland mares, by Mr. Bakewell. From a cross between these and a native stallion, that gentleman produced some noble animals. By this mixture of blood Mr. Bakewell got rid of much of the length and looseness of



form, and the long, thick, hairy legs attributed to the original breed ; and obtained a more compact and short-limbed animal, possessed of greater activity, and, as he alleged, of a better constitution, being more hardy and better able to stand constant work. If he carried this to a somewhat extravagant length, and sacrificed a little too much of that bone which, in every horse of strength, must have considerable development for the attachment of muscles, this defect has been rectified, and in that respect there is at present no deficiency in the breed.

Although the black colour, with a blaze on the face, and some white

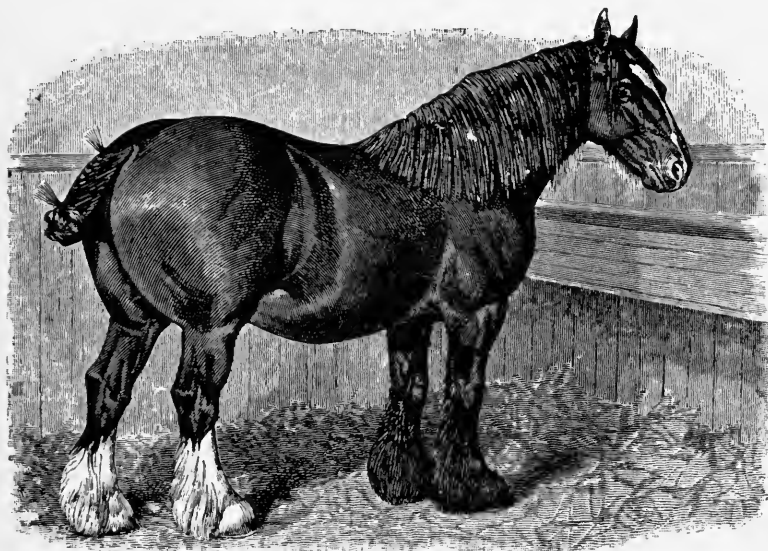


Fig. 85.—Shire Mare "Starlight," the Champion Mare at the London Shire Horse Shows, 1890, 1891, and 1892.

The Property of Mr. F. Crisp, New Southgate, Middlesex.

on the legs, may be regarded as the distinctive marks of this race, yet, in consequence of various crosses, they are now to be found of all colours. They are generally small-headed compared with their size, short-necked, with thick shoulders, short in the back, deep and round in the body, with broad back and loins, the quarters thick, the thighs and fore-arms peculiarly strong, and the legs short, with large round hoofs ; they possess great strength, and, although very slow, and apparently sluggish in their action, are not deficient in bottom ; but from their weight, as well as their natural power, go through draught work that could be performed by few other animals. That particular form commonly known as the *Dray-horse* is more especially a model of symmetry and strength combined. Not the least of his perfections is his extreme docility, which cannot fail of being an object of admiration

to everyone who witnesses his performances in the crowded streets of the metropolis.

THE CLYDESDALE race are strong, active, hardy animals, remarkably steady, true pullers, usually of sound constitution, and well adapted for all the purposes of husbandry; indeed, for the work of the farm, they cannot be surpassed. They are, therefore, deservedly in esteem among the northern farmers, particularly on heavy soils. They sometimes show a tendency to length of limb and lightness of body, but, apart from this, they are valuable farm-horses, and will work with more strength and continuance than almost any other kind. They are said to have descended from a cross, made by one of the Dukes of Hamilton, between some Flemish stallions, imported many years ago, and some Lanarkshire mares, and they derive their appellation from the valley of the Clyde where they are chiefly found. The story of their origin is, however, denied by a very intelligent writer on the subject,<sup>1</sup> who considers them an improved breed of the old Lanark race.

The Clydesdale Stud-Book (retrospective volume) contains a full account of the history of the Clydesdale breed, together with a description of its characteristic features and points, from which we take the following details:—

The head of the typical Clydesdale (figs. 86 and 87) is furnished with a broad jaw, ending, as a rule, in a not very fine or well-tapered muzzle, but with large open nostrils. His eye is usually full and vigorous, yet mild; his forehead broad and full between the eyes; while from the eyes the forehead tapers gradually upwards to the ears, which are long and active. Breeders of Clydesdales should attach considerable importance to these points, as a horse of such a description will generally be found to be of excellent temper, easily trained, docile, and very wise in cart or plough.

The neck should be strong, massive, and of medium height; while the shoulder should be more oblique than in the English draught-horse. This, indeed, is one of the distinctive features of the Clydesdale, as to his formation of shoulder is largely due his long, quick step, for which he is so justly admired. The "upright" shoulder of the English cart-horse may certainly give greater power in the collar; but if shortness and slowness of step be considered this cannot be called an advantage. The English horse, besides, is more accustomed to sheer dragging and to working in chains, while his Scottish rival is chiefly employed in the two-wheeled cart, which occasions a considerable amount of weight being balanced on the animal's back. A medium-slanted shoulder gives a horse, in such circumstances, an advantage; and doubtless those who carted the minerals of Lanarkshire in *ante-railroad* days found this formation well-adapted for their purposes. Even yet no one will affirm that it is unsuited to the traffic of the day, if he will only take the opportunity offered for forming an opinion by the sight of the Clydesdale horses yoked to a cart or lorry in the streets of Glasgow.

<sup>1</sup> Mr. William Aiton

Good sound legs and feet are essential to all horses, and are certainly not undervalued in the Clydesdales; in fact some judges, in their admiration of such good qualities, frequently lose sight of "top" altogether.

The forearm, from a side view, should be broad; loaded with long, strong muscles, so as to give full power to bring forward the part beneath; and in length should be proportionate to the length of the shoulder. A flat and broad knee is also essential.

The shank-bone should be flat from a side view, thick and gently rounded from a front view, and tapering to an edge as it goes back. The late Mr. Fulton used to say that he liked the "razor-legged" ones, an expression which conveys the idea of what this part should be. The back part from the knee down should possess a nice flowing fringe of silken hair, which should spring from the very edge of the bone. This hair should be of what a judge of a Skye terrier would style a "pily" nature; and good judges will not have a horse at all the feather of which has a coarse matted appearance. Possibly too much attention is paid by Clydesdale breeders to this point, and many will not exhibit at certain shows because their horses at the particular time happen to be what they term "bare of hair." The hair certainly creates a false impression of strength of bone, as an animal which has a broad forearm and well-developed knee, if deficient in "feather," does not compare well with one possessed of a nice flowing fringe several inches long; and this is decidedly disadvantageous. But the high value set upon nice silky hair is on account of its being in all cases a certain indication of a strong, healthy bone, as the hair of a short, coarse, matted kind suggests a decided tendency to grease. All horses have a tendency to lose their hair when being put into show condition (*i.e.*, loaded with fat like a bullock), and so "blistering," it is to be regretted, is commonly resorted to in order to strengthen its growth. The hair produced by this process is not, however, so silken or so fine as the natural, and the difference is easily detected by the practised eye.

The sinews of the leg should be thick, strong, thrown well back from the bone, and capable of being felt with the hand, if not, the leg is not a good one, however thick; as a soft, round leg, in which the sinews are not very well defined, will not stand work.

The lower end of the shank-bone, or fetlock, should also be large in all, so as to give full play to the tendons; and Clydesdale judges are very particular as to this, and also as to the pastern, which should be moderately sloped, and of a medium length.

Broad, low-set hind quarters, with muscular thighs, descending into broad and proportionately-developed hocks, sum up the good points of the hind end of the Clydesdale. Narrow hocks are so subject to thoroughpin, &c., that most breeders avoid them, even though there may be no perceptible marks of unsoundness. Straight hocks are not liked; but if the other parts are proportionate and the action is sound, no exception is taken to this formation. It is as a work-horse, however, that the Clydesdale should be considered; and it is questionable

if a straight hock affords as much propelling power as one moderately bent. The muscles surrounding the hocks should be strong and firm; and objection is always taken to animals which have them loose and flabby, or which, to use a breeder's phrase, have "fleshy hocks."

From the hock to the ground the leg should be short, broad, flat, clean, even, and straight or slightly inclined forward; the sinews standing out from the bone, and having a similar fringe of hair to that on the fore leg, and rising as high as the bottom of the hock-joint.

The hind pasterns are a little larger generally than the fore ones, and are more inclined, but not so much as to give the idea that they



Fig. 86.—Clydesdale Stallion, "Oyama" (13118).

Champion at the Scottish Stallion Shows of 1906 and 1907. The property of Mr. James Kilpatrick, Craigie Mains, Kilmarnock, N.B.

are not supporting the quarters. Short, steep, hind pasterns are a very bad fault, as the animal is always sticking its toes into the ground.

The average height of the Clydesdale horse is about 16 hands 2 inches, though there are several stallions to be found as high as 17 hands, but very few over that height. The fashionable colour is brown, that of a deep dark shade being preferred, and all the more so if dappled, while black is also common. Grey is not in favour, and few colts of this colour are kept entire unless very prepossessing otherwise. Grey mares, however, have often been used for breeding; and it is not very long since grey stallions took some of the best prizes of

the Highland and Agricultural Society. The colour is simply not liked, and few breeders on the Clydeside care to have their best mares served by grey horses. Clydesdale breeders are decidedly averse to chestnuts; and in some districts a chestnut horse, however good-looking and strong, would not be made use of, and indeed would be regarded by many as of impure origin. An occasional roan is to be met with; but this colour is regarded as evidence of impure blood.

White markings are now very common, and have come to be regarded as a sign of purity of blood; few of the Clydesdale horses of the present day are without white on one of the legs, while a white star or stripe on the face—"ratch," as some breeders term it, if of the latter form—is highly prized.



Fig. 87.—Clydesdale Mare, "Pyrene."

Champion at the Royal Agricultural Society's Show at Lincoln, 1907.  
The property of Mr. J. E. Kerr, Harviestoun Castle, Dollar, N.B.

In examining a horse when standing, a good judge will, in addition to running his eye over the various points mentioned, see that he stands even and firm on his feet, which in some horses are inclined slightly inward. To be the least inclined outward is a bad fault, and one which gets worse with age.

In walking, the horse should, if approaching you, come with his head well carried, and with an apparently measured stride, lifting his feet well off the ground, and placing them down again regularly, evenly, and with apparent deliberation.

On a side view one can notice if his action be even, *i.e.*, if his fore and hind action be in unison; for in horses with long backs and weak loins the two ends seem to be under different control, and the hind

legs, being in a manner dragged with the toes along the ground, an unpleasing effect is produced.

In going away at a walk, a horse should plant his hind feet forward as deliberately as his fore ones, at the same time raising and bending the leg at the hock, which should be evenly carried forward. If the hocks are turned out in moving them forward, the action is not good; and a Clydesdale breeder considers this an exceedingly bad fault in either horse or mare, though it is one which is commonly overlooked south of the Tweed.

In trotting, the horse should bend the legs at the knees and hocks, and from a hind view the inside of the fore hoofs should almost be seen at every step. If the animal be inclined to move wide behind, this fault will easily be discovered at the trotting pace.

Undoubtedly the place where the Clydesdale horse is seen to best advantage is at his work; and there can be no finer sight to a lover of draught-horses than a West of Scotland ploughing-match. At such gatherings 30 or 40 pairs may be seen at one time, each yoked abreast to the plough, moving slowly along, with that decisive, long, measured step which is one of the finest characteristics of the Clydesdale. He proceeds very cautiously withal, as though he were well aware that the success of the ploughman in a great measure depended upon himself.

The animals are all guided by words from the mouth of the ploughman, reins in many cases being dispensed with altogether.

In the ordinary "coup"-cart he steps freely out; and the business-like fashion in which he will lay his whole weight into the collar and drag heavy loads up-hill, stamps him as a splendid work-horse. In the streets of Glasgow he is possibly seen in his best form; there he is to be met with at every corner singly dragging heavily-laden lorries, to which in London a pair would usually be attached. Though active, he is generally possessed of a good temper and is easily broken.

His constitution is, as a rule, very healthy, and he stands wet possibly better than any other particular breed of draught-horses. With this statement we close our somewhat lengthy extracts from the retrospective volume of the Stud-Book.

Symmetry, activity, strength, and endurance, are, says another writer, the qualities most highly esteemed in a work-horse, and it is now all but universally admitted that the Clydesdale breed possesses every one of these valuable characteristics in as great a degree as any other. Many years have elapsed since Clydesdales ceased to be confined exclusively to their native valley, and at the present day many of the finest specimens are bred in Galloway, Ayrshire, Perthshire, &c., as well as in Clydesdale. While the pure-bred Clydesdale horse is justly held in high estimation as a work-horse, suitable for either the farm or the street, sires of this variety have deservedly been regarded with rapidly-increasing favour for crossing with mares of other breeds and countries. Indeed, they are unsurpassed in their wonderful adaptability for the improvement, by crossing, of the common farm-horse of almost every nationality. Hence, in recent years, considerable numbers of them have been taken to almost every part of England, and many

splendid animals have been exported to Canada, Australia, New Zealand, and other British colonies.

It is interesting to add that, as pointed out to us by a competent authority, several of the most successful Clydesdale stud-horses have had a considerable infusion of Shire Horse blood in their veins,—for example, Prince of Wales (673), and Darnley (222). When the greater substance, deeper ribs, and stronger thighs of the Shire are superadded to the indisputable quality of the Clydesdale, the result is admirable, as is well seen in the case of the Seaham Harbour Clydesdales of the Marquis of Londonderry.

THE SUFFOLK PUNCH is so denominated from his peculiar shape (figs. 88 and 89), and is a true farm-horse. It is said to have originated from a cross between a French stallion of a breed that has been long celebrated in Normandy and a Suffolk cart-mare. The Suffolk breed has been preserved more pure than many others; and, being neither handsome enough for a gentleman's carriage, nor weighty enough for a London cart or waggon, it is seldom employed for any other than agricultural labour. The old Suffolk Punch is now rarely to be met with. He was rather a plain-made horse, with large head, coarse muzzle, low fore-hand, straight back, flat side, shoulders too far forward, hind quarters rather high about the hips, deep-bellied and full in the flank, with round legs and short pasterns.

This is the account which Mr. Culley gives; and we immediately recognise in this description the horse that could throw his whole weight into the collar, and stand, without shrinking, a long day's work.

The present breed possesses many of the good qualities of its predecessors, but it has a considerable portion of Yorkshire blood mingling with it, and often an evident cross of the Flemish horse.

Mr. Cordy S. Wolton, a successful breeder, writes enthusiastically of the breed, in the "Live Stock Journal":—

"Their activity, combined with an iron constitution, their high courage, combined with docility, and their 'never say die' at a dead pull, instal them high in the favour of colonists who require horses to move a little quicker in front of the whippetrees than the ponderous Shire. Their legs hard and clean, like so much wire and whipcord; back and loins fit to carry a house; feet which will compare with any breed of horses anywhere; intelligent head, well put on; colour varying from the bright golden to the dark mahogany chestnut, sometimes touched with that beautiful metallic tinge which makes the coat flash like burnished brass, make up the *tout ensemble* which no horseman can fail to admire. The height of a Suffolk stallion would be from 16 to 16·3 hands; girth, 7 ft. 8 in. to 8 ft. 4 in.; weight, 1,900 to 2,240 lb.: size below the knee, 10½ in. The latter is often made a bone of contention between breeders of Suffolks and others, the latter contending that it is not big enough, forgetting that the bone of a hairy-legged horse looks bigger than it really is, owing to thicker skin and coarser hair; the Suffolk horse's is a closer made and harder kind of bone, it weighs more and looks less than it really is, and many prefer it to a coarse-

haired round-boned horse, even though the latter might measure more under the knee with the tape. Anyone comparing the cannon bone of a Suffolk with a hairy-legged horse after it has been skinned will at once see that the former is more like a piece of ivory, while the latter is coarse in texture. The Suffolk horse is also well adapted for mating with the thoroughbred mare for the purpose of breeding that most difficult of all animals to get—viz., the weight carrying hunter; and several of our most famous sires, Heir Apparent, Royalty, Viceroy, Dandy, &c., have been sold to Ireland with that object, and have met with success. The clean hard legs and size of the Suffolk, in conjunction with the blood and

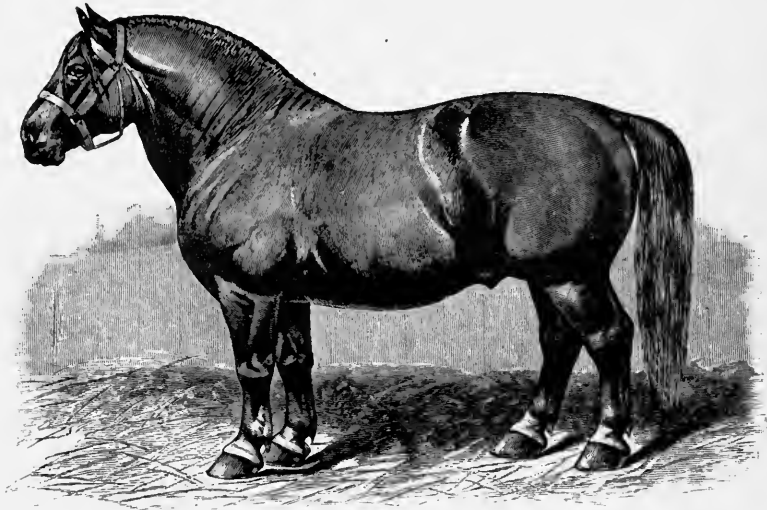


Fig. 88.—Suffolk Stallion "Wedgewood" (1749).

Winner of the Gold Medal presented by Her Majesty the Queen, and of the Champion Prize given by the Suffolk Stud-book Association for the best Suffolk Stallion at the Jubilee Show of the Royal Agricultural Society of England, Windsor, 1889. Bred by Mr. P. A. Posford, of Falkenham, Ipswich. Exhibited by Mr. Alfred J. Smith, of Rendlesham, Woodbridge, Suffolk.

staying powers of the thoroughbred, combine in the production of those necessary adjuncts to the hunter, size and speed, and from the impetus that the breeding of hunters is now receiving from the Royal and other societies, I expect to see the Suffolk horse and mare brought still further into play in this matter.

"The Suffolk Punch is pre-eminently an agricultural horse, will drag a ton behind him with ease, and will perform all the work that is required of him on the farm. Suffolk men, high and low, love their horses, as the Yorkshireman loves his thoroughbred and the Arab his steed, and grudge neither time, attention, nor labour to bring their equine friends to perfection. I venture to assert, without fear of contradiction, that he is what the talented editor of the Suffolk Stud-book



portrays him :—smart between the shafts in harness ; quick at the ends of the plough ; a fast walker on the harrows after the drill ; and a stanch slave at the collar, be it flour, timber, or chalk behind him—unsurpassed by any breed of horses in England, or Scotland either. For quality ; smart, sprightly, quick action ; ability to do long continuous days of hard work on comparatively meagre fare ; for longevity, and for most of the items that make a good horse, he would not come off second best in the keenest competition. Those who know him best appreciate him most ; and I believe Suffolk horses have a great future before them.”

To an extent not known in connection with other breeds of heavy

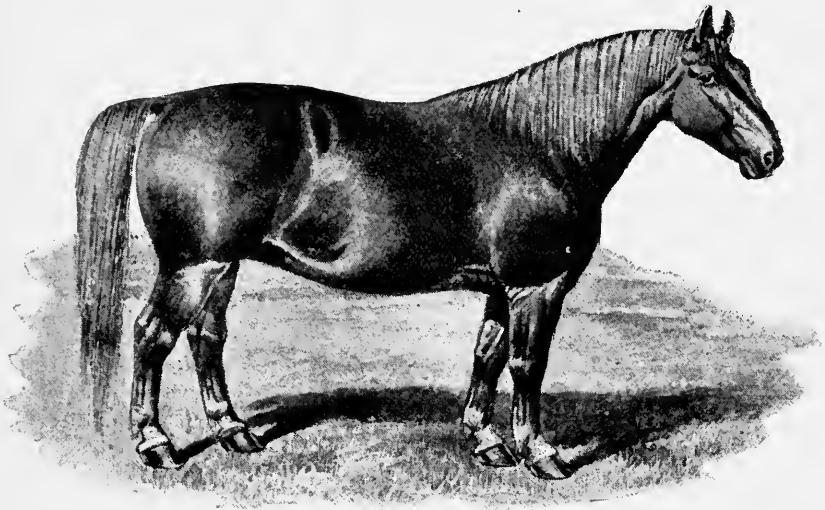


Fig. 89.—Suffolk Mare, “Bounce” (2517).

Winner of the Gold Medal presented by Her Majesty the Queen, and of the Champion Prize given by the Suffolk Stud-book Association for the best Suffolk Mare or Filly at the Jubilee Show of the Royal Agricultural Society of England, Windsor, 1889. Bred by Mr. Cady, of Long Melford, Suffolk. Exhibited by Mr. William Byford, of the Court, Glemsford, Suffolk.

horses, the Suffolks, remarks Mr. Blew, have retained their distinguishing characteristics. Shires, Clevelands, and Clydesdales, as we see them now, are admittedly the produce of frequent crossings, and owe their conformation, size, and distinguishing marks to the infusion of some particular strain of blood. When, however, we come to examine the history of the Suffolk, we are unable to discover that he ever resembled any other horse. He certainly was not always what he is now ; but there was always a difference between him and other breeds, and the veriest novice who ever entered a show-yard could never mistake a Suffolk for a Shire or a Clydesdale. It is worthy of notice, too, that so far as it is possible to trace the history of the Suffolks, we do not find that their present conformation is due to any crossing of

external blood with the stock indigenous to the soil, so to speak. It is also a curious fact that, while Shires and Clydesdales vary in colour, Suffolks are, and always have been, some shade of chestnut.

When Arthur Young, himself a Suffolk man, perambulated England and wrote his impressions, he did not hesitate to describe the Suffolk as one of the ugliest horses to be found in the country. He was big and plain about the head; low in the shoulder, small in the eye, and in other particulars did not correspond to the ideal of beauty. In Mr. Young's day the Suffolk was a small horse, and from various accounts appears to have been available for farm, saddle, and harness work; while he was also pressed into the service of carriage people before roads were as good as they are now.

Suffolk fox-hunters who find themselves compelled to ride over ploughland from the beginning of the season to the end may perhaps envy their ancestors who rode to hounds when Suffolk was a cheese- and butter-making county; yet much of it was so at the period when Camden penned his *Britannia*. In that publication, which was given to the world in 1586, occurs the first mention of the Suffolk horse. He might have existed, and probably did exist, for a long time prior to that date. Successful attempts have, however, been made to add to the stature of the Suffolk horse; and, as some critics affirm, at the expense of his legs, for they say that bone has not increased *pari passu* with the weight of his carcass. But this point must be settled by the Suffolk breeders themselves, who may, however, fearlessly assert that, if a shapely horse has been evolved out of unshapely ancestors, the dogged perseverance of the Suffolk has not been bred out of him. The more massive specimens are every whit as staunch at the collar as their more diminutive predecessors, though curiously enough some persons incline to the idea that the Suffolk horse has now less substance than he had forty years ago.

An admirer of the Suffolk horse, who sings its praises in the "Live Stock Journal Almanack," points out that the absence of hair on the legs, and the other characteristics of the Suffolk Punches, have come to be recognised as qualities which render them eminently suited for work of various kinds abroad. "Their clean legs tell in their favour, and they are quick and steady in cart or plough."

An exceedingly interesting history of the Suffolk horse is given in the Suffolk Stud-Book, 1880. It is concluded that the Suffolk horses of to-day are, with few exceptions, the descendants in the direct male line of the original breed, which Arthur Young describes as existing in the first half of the eighteenth century.

In addition to the breeds of horses that have been noticed there are, in almost every county, useful working animals of no definite race. There are also, unfortunately, mongrel breeds, whose only claim to be designated "farm-horses" arises from their not being fitted for any other purpose. The perpetuation of these half-bred ill-formed animals tends greatly to depreciate the good old breeds with which they are too often mixed. The mixture or rather infusion of the "blood" of

high-bred animals, such as the "English Hunter," has been advocated by many authorities as likely to be conducive to the great improvement of the breed of horses ordinarily used on the farm. Whether such high-bred "blood" as that of the hunter be so used or not, certainly, in view of the wretched "screws" which are too often used for the sake of economy to raise stock with, some decided reform was obviously required. In this direction, the work undertaken by the Royal Commission on Horse Breeding is likely to have a salutary and permanent influence upon the equine stock of Great Britain.

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## CHAPTER II.

### THE ANATOMY OF THE HORSE.

**T**HOUGH it is possible to treat this branch of the subject in only the briefest fashion, it is believed that the few facts related in this chapter will prove of direct interest to breeders.

**THE SKELETON.**—The "backbone" of the horse is made up of 7 cervical (or neck) vertebræ; 18 thoracic (or dorsal) vertebræ, supporting the ribs; 6 lumbar vertebræ; 5 sacral vertebræ, fused together to form the sacrum; and about 17 caudal (or tail) vertebræ. Above the cervical vertebræ is the stout ligament of the neck, the *ligamentum nuchæ*. Of the spines on the upper faces of the thoracic vertebræ, that on the fifth is the longest, that on the sixteenth is vertical. Those in front of the sixteenth are inclined backwards (see fig. 90).

The thorax, or chest, is a cone-shaped cage supported by a bony framework, consisting of the thoracic vertebræ above, the ribs at the sides, and the sternum, or breast bone, below. The sternum is much compressed laterally, and projects forward like the prow of a boat. Within the thorax is lodged the heart, on either side of which are the lungs. The thorax is completely shut off from the larger hinder cavity of the body (the abdomen) by a tense muscular sheet or skirt, called the diaphragm, which, however, is pierced by the great blood-vessels and the gullet. In the abdomen are lodged the stomach and intestines, with their attendant glands (liver, pancreas, and spleen), also the kidneys, the urinary bladder, and (in the female) the ovaries and uterus. The cavity is traversed, in the upper median line, by the dorsal aorta conveying blood from the heart, and the inferior vena cava taking blood to the heart.

The ribs number 18 pairs, so that between them there are 17 intercostal spaces. Each rib articulates with a vertebra above; and communicates with the sternum below, either directly or indirectly, by means of costal cartilages. Each rib consists, therefore, of a bony part

above and a cartilaginous part below. Of the 18 pairs of ribs, the costal cartilages of the first eight pairs have a separate and independent attachment with the sternum; these are called true or sternal ribs. Of the remaining ten the cartilages become more or less confluent, and reach the sternum, if at all, collectively; these, therefore, are called false or asternal ribs. The length of the ribs increases from the first to the ninth, then diminishes. The width increases from the first to the sixth, then diminishes. The curve of each rib is shorter and more pronounced, the farther the rib is from the head of the horse. The mobility of the ribs is hardly perceptible in the first pair; it increases to the ninth or tenth, then diminishes.

The pectoral arch, or shoulder girdle, consists of a pair of scapulæ,

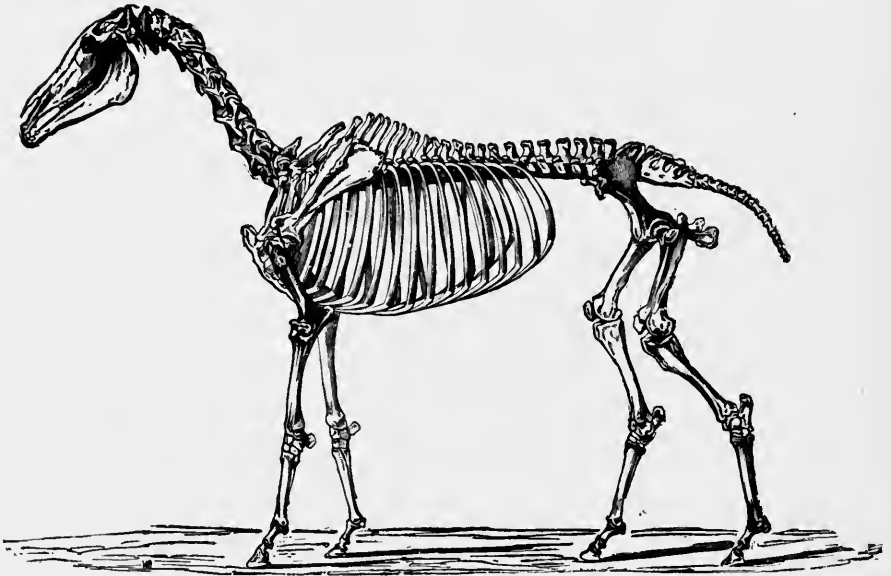


Fig. 90.—Skeleton of the Horse.

or shoulder blades, one on each side. There are no clavicles, or collar bones. The scapula is long, slender, and has a ridge only slightly developed. As, however, this ridge is thickened and turned *backwards* somewhat above the middle, there is no difficulty in determining whether a dry scapula is right or left. The upper free margin of the scapula is bordered by a cartilage (the supra-scapular cartilage), which becomes ossified in old horses.

The upper end of the humerus, or shoulder bone, articulates with the glenoid cavity at the lower extremity of the scapula. Inferiorly, the humerus articulates with the radius.

Of the two bones—radius and ulna—which make up the typical forearm in vertebrate animals, the radius alone is well developed in the horse, the ulna being represented only by its upper part, which is

firmly ankylosed to the radius, and projects from the upper end thereof in the prominent olecranon process.

The carpus, or wrist—popularly termed the “knee” of the horse—consists of seven bones in two rows (fig. 91). The upper row comprises the following four bones, named from within outward:—

*Pisiform, Cuneiform, Lunar, Scaphoid.*

The lower row includes three bones, the first-named being innermost:—

*Unciform, Magnum, Trapezoid.*

As the pisiform is really above and behind the carpus it is often

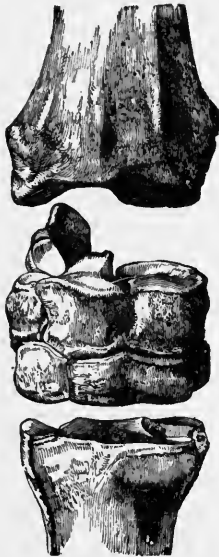


Fig. 91.—Front View of the Right Carpus, or “Knee,” of the Horse.

Showing the lower end of the radius above, the upper end of the cannon bone below, and the carpal bones between.



Fig. 92.—Side View of the Bones below the Carpus of the Horse.

Showing the lower end of the cannon bone, with the two floating bones (sesamoids) behind, then the pastern, the coronet, and the coffin bone, with the “navicular” behind the junction of the two last-named.

called, by veterinarians, the supercarpal bone. Of the remaining bones in the upper row, the scaphoid is larger than the lunar, and the lunar than the cuneiform. In the inferior row the unciform is thickest, the trapezoid thinnest, the magnum largest, the trapezoid smallest.

Of the five normal digits the horse has only the middle one—the third—fully developed. The first and fifth are entirely absent, and the second and fourth are reduced to mere splint bones flanking the third. The metacarpal bone, called the cannon bone or shank bone, corresponds

with the middle bone of the human palm, and is one of the most compact bones in the horse. The splint bones correspond with the second (forefinger) and fourth (ring-finger) bones in the human palm, and the interosseous ligament between these and the cannon bone often becomes ossified in old horses. The splints do not extend the whole length of the cannon-bone; each terminates in a button-like process.

The solitary digit on the horse's fore limb (Fig. 92) represents the middle finger of man, the three bones in each corresponding thus:—The pastern bone (*os suffraginis*) of the horse is equivalent to the basal joint of man's middle finger, the coronet bone (*os coronæ*) represents the middle joint, and the pedal or coffin bone (*os pedis*) of the horse corresponds with the terminal joint of the human middle finger. This last-named joint in man bears a nail, and similarly the coffin bone in the horse is covered with a hoof, which is nothing other than an enormously developed nail.

At the back of the articulation of the pastern with the cannon bone are two floating bones (*sesamoids*), which support the ergot and the fatty cushion of the fetlock, the latter in some breeds being covered with coarse hair like that of the tail. These "footlocks" are peculiar to the horse, and vary in length and coarseness with the breed.

The coronet bone, or small pastern, articulates above with the pastern, and below with the coffin bone. At the back of the junction of the coronet and coffin bones is another floating bone, the "navicular" of veterinarians. It rests upon the fibrous elastic structure called the plantar cushion, and is the seat of navicular disease.

The nail (*Lat. ungula*) is developed not only upon the back but upon the face and the sides of the coffin bone, so that the horse is *unguligrade*.

The hip girdle, or pelvic arch, consists of two equal pieces, called the *coxæ*, or *ossa innominata*, which, by their union with the sacrum above, constitute the long cavity of the pelvis. Each coxa is an irregular flat bone, directed obliquely from above to below and from before to behind. In the foetus, the coxa is formed of three distinct bones, the ilium in the forward position, the ischium behind, and the pubis below. The two pubic bones become united together to form the symphysis pubis, whilst the tail hangs down between the two ischia. The three bones—ilium, ischium, pubis,—all meet together in a great cavity called the acetabulum, which looks downwards and outwards, and into which the head of the femur, or thigh-bone, fits. The long axes of the *coxæ*, or *ossa innominata*, which determine the relative dimensions of the "quarters" in the horse, form an acute angle with the vertebral column or backbone.

The pelvis, as the bony basin of the hip girdle is called, is a simple conoid cavity, in which the front aspect or inlet is far more extensive than the hinder aspect or outlet. The pelvis of the mare exceeds that of the horse in all dimensions, but the difference is most marked in the transverse diameter. The inlet has a much greater circumference in the mare. The floor of the mare's pelvis, moreover, is wide, and its bones tend towards the same horizontal plane. In the mare the distance

between the acetabulum and the symphysis pubis is greater than in the horse.

To the head of the femur, or thighbone, is attached the round ligament (*ligamentum teres*), which helps to fasten it in the acetabulum. The lower end of the femur is furnished with a pulley-like surface, or trochlea, on which the patella, or knee-cap, glides.

The leg comprises three bones, the tibia, the fibula, and the patella; the first-named being by far the largest. The tibia is a long prismatic bone, much thicker at its upper end. It extends downwards and backwards, articulating with the femur above and with the astragalus below, the latter by means of a perfect hinge-joint. The fibula is a slender elongated bone, on the outer side of the tibia, and extending about halfway or two-thirds along the latter. The patella is a small, very compact, "floating" bone, attached to the tibia by three strong ligaments.

The region immediately below the tibia is known as the tarsus or hock. It contains six bones, called tarsals. In the upper row are two,—the calcaneum, or heel bone, on the outer side, and the astragalus on the inner side. In the inferior row, beneath the calcaneum, is the cuboid, whilst beneath the astragalus is the true navicular, and beneath that a couple of cuneiform bones side by side (see diagram on page 411).

The astragalus is an irregularly cubical bone, its articulating surface forming the most perfect pulley or trochlea in the body. The calcaneum is a vertical elongated bone, flattened on both sides. The cuboid is small and elongated. The navicular and the cuneiform bone next the cuboid are very broad flat bones, much resembling each other in shape, though the navicular is the larger.

The metatarsal and digital regions in the hind limb are an exact counterpart of the metacarpal and digital regions in the fore limb—the cannon bone with its splints on either side, and the single middle digit made up of pastern, coronet, and coffin bones.

Because the horse has one finger on each hand (fore limb), and one toe on each foot (hind limb), he is called a monodactyle animal. The ox and sheep (two-toed), are bidactyle: the pig (four-toed), is tetradactyle. Man is pentadactyle, so is the elephant.

An homologous relationship between the fore limbs and the hind limbs is obvious. The corresponding parts are indicated in the subjoined table:—

FORE LIMB.	HIND LIMB.
Shoulder Girdle, formed of the two scapulæ.	Hip Girdle, formed of the two ossa innominata.
Humerus . . . . .	Femur.
{ Radius . . . . .	{ Tibia. }
{ Ulna . . . . .	{ Fibula. }
Carpals . . . . .	Tarsals.
Metacarpal region . . . . .	Metatarsal region
(Cannon bone).	(Cannon bone).
Digital region . . . . .	Digital region
(Pastern, coronet, and coffin bone).	(Pastern, coronet, and coffin bone).

**THE HOOF.**—The coffin bone, the navicular, and the lower end of the coronet form “the articulation of the foot.” Four ligaments bind this articulation together. In addition, the extensor tendon passes down in front, and the flexor tendon behind. Outside these structures are the two fibro-cartilages, one on each side, united behind and below by the plantar cushion. Outside, again, and fitting on the foregoing like a sock on a foot, is the keratogenous (*i.e.*, horn-forming) membrane, which secretes externally the epidermal material known as horn, of which the hoof is composed. The entire region is richly supplied with blood-vessels and nerves. The hoof is seen to become continuous with the ordinary skin at a circular line extending round the middle of the coronet; below, both in front and at the sides, is a semicircular protuberance, the coronary cushion. That part of the keratogenous membrane spread over the anterior face of the coffin bone is called the laminal or leafy tissue, because of the laminae or parallel leaves seen on its surface; inflammation of this structure is called laminitis.

The hoof fits closely on the keratogenous membrane, of which, indeed, it is the product. Its general shape is that of a cylinder cut across obliquely. Prolonged maceration causes it to separate into three parts: the wall, the sole, and the frog.

The *wall*, or *crust*, is that part which remains visible when the hoof rests upon the ground. The middle anterior part is the *toe* (*outside* and *inside*); the lateral regions are the *quarters*; the angles of inflection at its hinder extremities are the *heels*; from thence, passing along the inner border of the sole are the *bars*, which form outwardly the external faces of the *frog*. The *sole* has a large external curved border, and a much shorter internal border taking the form of a deep V-shaped notch, widest behind. This latter corresponds with the bars, at the meeting of which the point of the frog is fixed. The *frog* is a pyramidal mass of horn lodged between the two re-entering portions of the wall. A *median lacuna* divides the inferior face of the frog into two divergent branches, the round, flexible, elastic, free ends of which are the *glomes*. The inclination of the wall of the hoof is from 50° to 56°, not 45° as is often supposed. The flexibility of the hoof is promoted by a fluid thrown out by the keratogenous membrane. At the junction of the wall and sole is the *white line*; it is soft and flexible and so prevents the breaking of the sole from the wall. The growth of the wall may continue indefinitely, but the sole and frog after attaining a certain thickening begin to peel off, unless otherwise kept down. The wall grows from its superior to its inferior border, like the human nail. The sole and frog grow from their internal to their external face.

**THE SKULL.**—The head of the horse is nearly vertical, and the bones composing it are distinct and separate only when very young. Those that enter into the boundaries of the brain-case are called the cranial bones, the external ones of which are the occipitals, parietals, frontals, and temporals. The frontal bones, in the space between the eyes, are pierced by the pole-axe when a horse is slaughtered. By far the larger part of the horse's skull is that occupied by the facial bones. Of these, the most prominent as seen from the outside, are the malar or jugal,



beneath the eye; the lachrymal, a small bone, at the inner inferior angle of the eye; the nasals, triangular elongated bones covering the

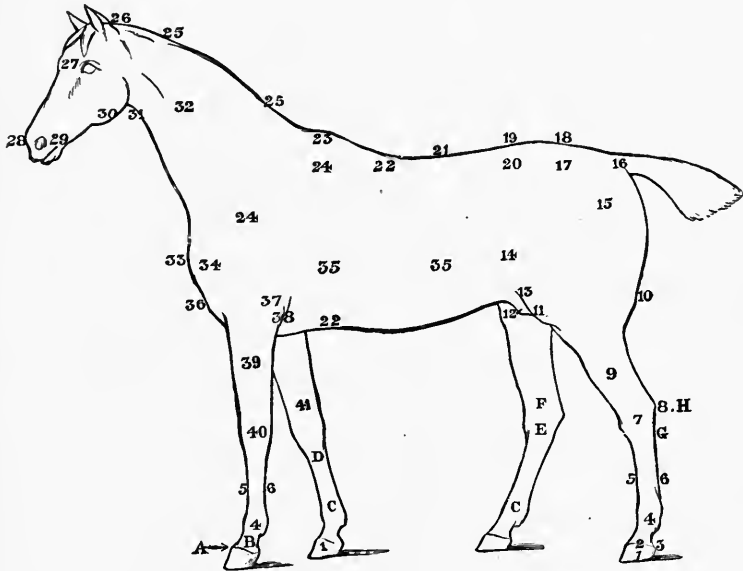


Fig. 93.—Points of the Horse.

- |                                |   |
|--------------------------------|---|
| 1. Hoof.                       | 22, 22. Girth, or Chest Measurement                               |
| 2. Coronet.                    | 23. Withers.  |
| 3. Heel.                       | 24, 24. Shoulder Blade or Scapula.                                |
| 4. Fetlock or Pastern Joint.   | 25, 25. The Crest.  |
| B. The Pastern.                | 26. The Poll.   |
| 5. Cannon Bone.                | 27. The Forehead.   |
| 6. Back Sinew or Tendon.       | 28. The Muzzle.   |
| 7. The Hock or Tarsus.         | 29. The Nostril.  |
| 8. Point of Hock.              | 30. The Jaw.  |
| 9. Second Thigh.               | 31. The Throat, or Windpipe.                                      |
| 10. Hanch or Lower Buttocks.   | 32. The Neck.   |
| 10 to 20. The Quarter.         | 33. Point of Shoulder.  |
| 11. The Stifle.                | 34. The Shoulder.   |
| 12. The Sheath.                | 35, 35. Front Ribs, and Back or Short Ribs<br>forming the Barrel. |
| 13, 14. The Flank.             | 36. The Chest or Breast.  |
| 15. The Hip Joint.             | 37 to 34. The True Arm, or Humerus.                               |
| 16. Root of Tail or Dock.      | 38. The Elbow.  |
| 17. The Rump.                  | 39. The Arm (so-called) or Fore-Arm.                              |
| 18. The Croup.                 | 40. The Knee or Carpus.   |
| 19. The Loins.                 | 41. The Chestnut.   |
| 20. Point of Hip Bone (Ilium). |   |
| 21. The Back.                  |   |

SEATS OF COMMON DISEASES.

- |              |              |                 |                 |
|--------------|--------------|-----------------|-----------------|
| A. Sidebone. | C. Windgall. | E. Spavin.      | G. Curb.        |
| B. Ringbone. | D. Splint.   | F. Thoroughpin. | H. Capped Hock. |

cavity of the nose; the supra-maxillaries, the largest bones in the upper jaw, forming most of the cheek, and lodging the upper molar

teeth; and the pre-maxillaries, lodging the upper incisors. The roof of the mouth is occupied by the palatal bones, which separate the mouth from the nasal cavities. The lower jaw or mandible consists of a pair of flat bones (right ramus and left ramus), united in front at the symphysis rami, and each articulating by means of its condyle with the squamosal bone of the skull.

Various details in the external conformation of the horse are indicated in fig. 93, which may be usefully compared with the diagram of the skeleton (fig. 90).

**THE ALIMENTARY CANAL.**—The digestive tract consists of a tube of varying diameter, commencing at the mouth, and ending at the anal aperture. The course taken by the food is:—mouth, pharynx (a large chamber at the back of the mouth), œsophagus or gullet, stomach, small intestine, large intestine, rectum. The food is comminuted in the mouth, the lips, cheeks, tongue, hard palate, soft palate, and teeth, all taking their share in the work, whilst the salivary glands (the parotid, submaxillary, sublingual, and molar or buccal) simultaneously pour out their juices. Mixed with abundant saliva the food is transferred to the pharynx, whence it passes into the gullet, which is merely a tube along which the food can travel to the stomach, this last-named organ being a dilatation of the alimentary canal. Here the true work of digestion begins, the gastric juice, secreted by the peptic glands in the internal lining of the stomach, effecting the solution of the nitrogenous ingredients (proteids) of the food, which are carried away as dissolved peptones by the blood circulating in the delicate blood capillaries of the wall of the stomach.

Passing through the pyloric aperture the alimentary mass emerges from the stomach into the small intestine, where other digestive juices, notably that of the liver (the bile), and that of the pancreas or sweetbread (the pancreatic juice), further attack and disintegrate the food. The physiological nature of these processes is discussed in the chapter on the Secretion of Milk (pp. 271 to 295).

The diagram (fig. 94) indicates the "regions" of the abdomen as conventionally marked out on the inferior face of the abdominal wall, viewed from below.

The stomach of the horse is a membranous muscular sac possessing an average capacity of 3 to 3½ gallons, though it varies according to the size of the animal, the breed, and the food. It is relatively larger in common-bred horses, and in the ass and mule. Its average weight when empty is 3 to 4 lb. Elongated laterally, and curved on itself, it is often constricted in the middle. Interiorly the left half is lined by membrane like that of the gullet, and contains no peptic glands. The right-hand half of the inside is, on the contrary, thick, wrinkled, spongy, very vascular, and richly beset with the glands which secrete the gastric juice. Hence, it is only the right hand side of the interior of the horse's stomach which has any true digestive power; the transition from the functionless left to the functional right is indicated internally by a sharply-marked ridge with which an external constriction corresponds. In the human stomach the whole of the internal

lining membrane is functional, whereas in that of the horse there is a kind of foreshadowing, as it were, of the much greater subdivision of the stomach characteristic of ruminants (oxen, sheep, goats, deer, &c.). Anteriorly the stomach is in relation with the diaphragm and liver, posteriorly with that part of the large intestine called the colon. On the left side of its inferior border is the spleen, slung up in the great omentum, a loose part of the glistening membrane which covers the stomach externally. In animals in good condition the great omentum is laden with a considerable amount of fat or flare.

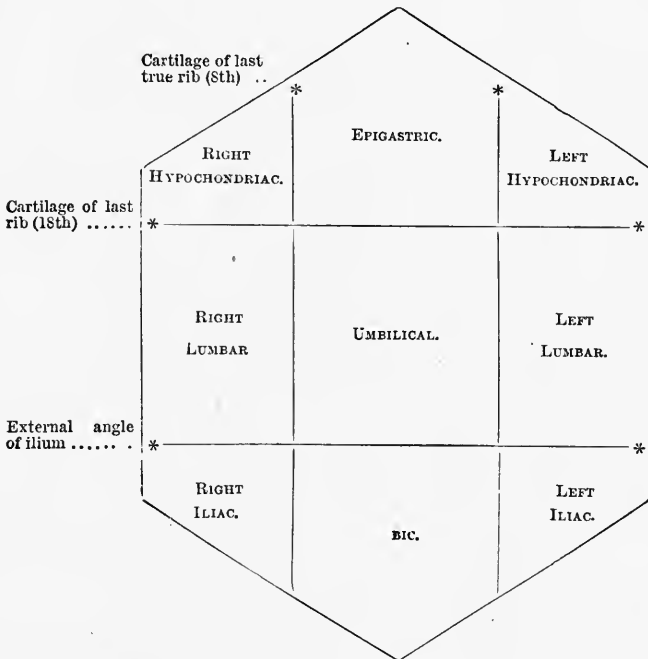


Fig. 94.—The "Regions" of the Abdomen.

There is one very important difference between the stomach of the horse and that of the ox, sheep, pig, dog, and man, namely, the mode in which the gullet expands into the stomach. In the horse, the gullet enters the stomach perpendicularly and abruptly by a very narrow aperture, which, though it allows material to pass into the stomach, opposes a formidable obstacle to its passage backwards into the gullet. In the other animals named the gullet opens gradually, like a funnel or tun-dish, into the stomach. Hence, in the horse, vomiting is difficult, if not impossible, and he is accordingly an exceedingly bad subject to physic with emetics.

The small intestine is a narrow tube coiled up, and slung in folds of the mesentery, in an almost indescribable fashion. The peritoneum is the name given to the smooth moist membrane which envelops, and

keeps in position, most of the abdominal organs. The great omentum and the mesentery are portions of the peritoneum, which is really a double sheet with its two faces in contact, the blood-vessels to and from the stomach and intestines passing between them. In a horse of average height the length of the small intestine is about 70 feet, and its diameter is 1 inch to  $1\frac{3}{4}$ . It opens abruptly, at the ileo-cæcal valve, into the large intestine.

The large intestine consists of cæcum, colon, and rectum. The cæcum, or blind-gut, is a very wide elongated sac, extending obliquely downwards and backwards. Its length is a little over 3 feet, but it has a capacity of  $7\frac{1}{2}$  gallons,—about twice that of the stomach. It serves as a temporary reservoir for the large quantities of fluid ingested by herbivorous animals.

The colon, 10 to 13 feet long, has an average capacity of 18 gallons. Its terminal part is a bosselated tube in which the fæces of the horse are moulded into their characteristic shape before passing into the rectum, whence they are expelled.

The liver, the largest gland in the body, is wedged in between the stomach and the diaphragm. It is made up of several lobes, and is remarkable in the horse as possessing no gall-bladder, the flow of bile taking place when required along the bile-duct, or *ductus choledochus*. The healthy liver of a horse of average size weighs about 11 lb.

The pancreas, or "abdominal salivary gland," weighs a little over 1 lb. It is spread out on that portion of the mesentery near the commencement of the small intestine. The spleen weighs about 2 lb., but it is sometimes three or four times its normal volume.

URINARY ORGANS.—The kidneys are imbedded securely beneath the muscles in the region of the lumbar vertebræ. They are kept in position, partly by the cushion of fat on which they rest, partly by the peritoneum passing beneath them, and partly by the pressure of the digestive organs. The right kidney, which is beneath the last two ribs, is more forward than the left; the former weighs about 27 oz., the latter about 25 oz. They differ also in shape.

The urine, separated from the blood in each kidney, is continually flowing along a tube (the ureter, right and left) into the bladder, which is a reservoir from which the fluid can be expelled as occasion may require. The horse's bladder is very thin; its average weight when empty is 1 lb. Its exit tube, the urethra, is guarded by a sphincter muscle at its junction with the bladder. The urine contains most of the nitrogenous waste of the body.

BREATHING ORGANS.—The respiratory apparatus of the horse is of a normal character. The nasal cavities are bounded by the nostrils, the external skin of which is fine, thin, pigmented, and often spotted. Their lips are extremely dilatable, as may be especially noticed in the case of high-bred horses after exertion or excitement. Horses and other solid-hoofed animals can only breathe through the nose, the soft palate at the back of the mouth being so extensively developed as to prevent breathing through the mouth. The course of the air

in inspiration is—nasal cavities, pharynx, glottis, trachea, bronchi, bronchial tubes, air-cells of the lungs.

The trachea, or windpipe, is a flexible elastic tube, formed of about fifty rings of cartilage or gristle, which are incomplete behind, that is, along the line where the œsophagus touches the trachea throughout its length. The organ of voice, the larynx, is a cartilaginous box at the top of the trachea. When food is swallowed, the act of deglutition causes a little lid, the epiglottis, to close the entrance to the trachea, over which therefore the food glides towards the œsophagus.

The trachea breaks up primarily into two bronchi, each of which is constructed like a small trachea. Each bronchus branches like a tree, the ultimate ramifications with their air-cells constituting the spongy texture of the lungs.

The lungs are completely enveloped in a delicate, transparent, glistening, serous membrane, called the pleura, which is reflected over the internal walls of the thorax, so that in the movements incident to breathing, the moist smooth surface of the pleura of the lung glides upon the similar surface of the pleura of the wall of the thorax.

THE ORGANS OF CIRCULATION.—The apparatus of circulation consists of the heart, a central organ whence the blood is propelled; the arteries, or tubes (vessels) which carry blood *from* the heart; the veins, or tubes (vessels) along which blood travels *to* the heart; blood capillaries, very delicate tubes with permeable walls, forming the connection outside the heart between the arteries and the veins; the lymphatics, a system of spontaneously arising capillaries and veins which collect the lymph, or overflow from the blood amongst the tissues, and return it to the heart.<sup>1</sup>

The heart is a hollow muscle, divided lengthwise into two independent chambers—the right side on the track of the dark (or venous) blood, the left side on the track of the scarlet (or arterial) blood. Each chamber of the heart is again divided into two, the auricle above, and the ventricle below. The whole organ is enclosed in a delicate serous membrane like the pleura, called the pericardium. Internally there is a similar lining membrane, the endocardium. The heart is situated opposite the third, fourth, fifth, and sixth pairs of ribs. Its base is forward, whilst its apex points downward in the direction of the diaphragm. It is about 10 inches long, its antero-posterior diameter

<sup>1</sup> From the minute hair-like tubes (capillaries) in which arteries end, the portion of the blood which contains all the nutritive elements is constantly leaking into the tissues, which use what amount of it they require, while the rest is taken up into the absorbent vessels (lymphatics), and again is poured into the blood on its return to the heart through the veins by the thoracic duct. The blood is therefore always giving up something to the tissues, and always getting something back again from the absorbents, the total result being that the blood-vessels get rid of the whole quantity of blood which they contain, and get back a similar bulk of new fluid about every twenty-four hours. But like the air in the lungs, the fluid is never entirely good, nor altogether bad; it is constantly giving up its best materials, and as constantly getting back a mixture of good and bad: the good to be used for the support of the structures, and the bad to be excreted from the skin, kidneys, intestines, and other excretory organs, whose beneficent action is continuous, indeed cannot be interrupted for a short time even without damage to health, if not risk of life.—Sir George Brown, C.B., in *Journal of the Royal Agricultural Society*, vol. xxii., second series, 1886.

near the base being  $7\frac{1}{2}$  inches, and its lateral diameter 5 to  $5\frac{1}{2}$  inches. Its capacity varies from a pint to a pint and a quarter on each side. Its empty weight is about  $6\frac{3}{4}$  lb., but it is much greater in well-bred than in under-bred animals.

The auricles receive blood, whence it passes into the ventricles, the muscular contractions of which drive the blood out of the heart. Impure blood derived from all parts of the body except the lungs is poured by the venæ cavæ into the right auricle, whence it passes into the right ventricle, and is driven thence along the pulmonary artery into the lungs, where it loses carbonic acid gas and water vapour, gains oxygen, and changes colour from dark (almost black) to scarlet. The pulmonary arteries collect the purified blood from the lungs and pour it into the left auricle, whence it passes into the left ventricle, from which it is driven out through the aorta, which distributes it to all parts of the body except the lungs. Foul and impure, it again finds its way to the right side of the heart, and so the circulation goes on.

Where the auricles open into the ventricles, and where these latter empty into the great arteries, valves are attached. They work in such a fashion as to aid the flow of the blood in the proper direction, and impede its course in the opposite direction. Most of the veins have valves which work on a similar principle.

Just as the arteries break up into narrower arteries and ultimately into capillaries, so do these latter become at length confluent into small veins, which eventually merge into large veins. As a rule the veins are more superficially seated than the arteries, and not uncommonly one artery is paralleled by a couple of veins. A prominent superficial vein is the jugular, corresponding with the more deeply seated carotid artery. The carotids, on either side, carry blood to the head, the jugulars take it back towards the heart. The jugular vein can easily be felt in the channel extending the length of the horse's neck. To "fill the jugular," press that portion of it nearest the heart, and the vein will at once become "knotted," owing to the valves floating across the vessel and preventing the blood from flowing back again into the head. The pulse is the shock communicated by the contraction of the left ventricle; it can be felt in the arteries, but is lost ere the blood reaches the veins. The normal pulse in the horse is about 36 per minute, in the ox 55, and in the sheep 75.

**THE NERVOUS SYSTEM.**—The brain and spinal cord, constituting the cerebro-spinal nervous axis, are securely lodged in the bony cavity, or canal, formed by the skull and the vertebræ. The spinal cord, which extends along the "backbone" to the sacral region, may be regarded as an attenuation backward of the tissues of the brain; or, conversely, the brain may be looked upon as an enormous development anteriorly of the spinal cord. The aperture at the back of the skull through which the brain becomes continuous with the spinal cord is called the *foramen magnum*, or the occipital foramen. This region of the cerebro-spinal nervous axis is termed the *medulla oblongata*. Cranial and spinal nerves are distributed in pairs from the axis to the various

parts of the body. The former are highly important, some of them constituting nerves of special sense, such as the olfactory, the optic, and the auditory.

THE EYEBALL consists of a tough fibrous coat, transparent in front, and enclosing two liquid or semi-liquid masses, the vitreous humour and the aqueous humour. At the back, the optic nerve enters it. In front may be seen the transparent cornea, in the centre of which is the pupil, fringed by a delicate muscular curtain of varying diameter, the iris, which gives the "colour" to the eye. The iris, though variously coloured, is usually brownish-yellow in the horse; if it is nearly white, or bright grey, the horse is "wall-eyed." The eyeball is lodged in the orbital cavity, which is a recess, formed by the orbital process of the frontal bone, and the margins of the frontal, lachrymal, and malar bones. Posteriorly there is a fibrous membrane, the ocular sheath. The orbital cavity lodges, besides the ball of the eye, its muscles, also the membrana nictitans, and the lachrymal gland.

The movements of the eye of the horse are controlled by seven muscles,—five rectus muscles, and two oblique. The posterior rectus muscle, or retractor oculi, forms a sheath round the optic nerve, and is of use in drawing the eye backward into the orbit in case of danger. The superior, inferior, external, and internal rectus muscles are parallel with the posterior rectus, and repeat on a larger scale the disposition of the four bundles of the latter. Their function is, by their respective contractions, to turn the eye upward, downward, to the right, or to the left, as the case may be. The great oblique and small oblique muscles move the eyeball obliquely.

The protective organs of the eye are seen externally. The eyelids have two commissures, the superior one at the temporal angle, and the inferior and rounder one at the nasal angle. The eye-lashes divert dust and other matters that might otherwise enter the eye. The Meibomian glands on the margins of the eyelids pour out an unctuous secretion, offensive to insects. The conjunctiva is an extremely delicate transparent membrane covering the front of the eyeball, and keeping it moist. The membrana nictitans (winking eyelid) is a third eyelid, which maintains the healthy condition of the surface of the eye by removing any matters that may have escaped the eyelids. It sweeps across the eye transversely from the nasal angle.

HEREDITARY DISEASE IN THE HORSE.—The propagation of hereditary disease amongst live stock is as undeniable a fact as the propagation of other characters from parent to offspring. It is, therefore, incumbent upon all breeders who are worthy of the name to take as great trouble to prevent the transmission of disease, as they do to promote the perpetuation of useful and desirable peculiarities. Accordingly, certain hereditary diseases have been scheduled by the Royal Commission on Horse Breeding as rendering stallions unfit for stud purposes. These diseases are:—Roaring, whistling, ringbone, unsound feet, navicular disease, spavin, cataract. A horse suffering from any of these disorders should not be allowed to become a parent, the probability being that the disease would reappear in the offspring. Without entering at

this stage into any discussion of these diseases, scheduled as transmissible from parent to offspring, it will nevertheless be appropriate to indicate here the seat of each of the disorders which have been named. The following brief notes may be read in connection with, though they are given independently of, the foregoing anatomical details.

*Roaring* is a complaint arising from some injury to the respiratory passages, and usually to the larynx. In the front of the neck can be felt the ringed trachea or windpipe, leading from the large cavity (the pharynx) at the back of the mouth to the lungs. The larynx, at the upper end of the trachea, is a complicated cartilaginous box, which contains the membranes called the vocal chords, the passage of air through which causes the vibration that results in the production of the voice. The vocal chords are usually under the control of the animal; they can be approximated to each other, or allowed to remain apart. In the former case, sound is produced when the air from the lungs is forced between the chords. If the control over the muscles which govern the vocal chords is lost, as in paralysis, respiratory sounds will continually accompany the breathing, and this may be a common symptom of roaring. The larynx occupies the same relative position in a man as in a horse, and in some people it becomes greatly developed into the protuberance known by the name of Adam's apple. It is instructive to watch the motion of the larynx when a person is singing, the transition from high to low notes being accompanied by the movements associated with the different adjustments of the vocal chords. Whistling is a modified roaring, and its seat may be either in the larynx or in some other part of the trachea.

Unsound feet, ringbone, navicular disease, and spavin are all disorders of the bones, or joints, of the limbs.

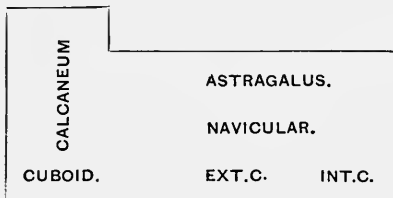
*Ringbone* is an exostosis, that is, an abnormal bony outgrowth, in the region of the pastern bone, and its presence is noticeable either at the joint of the cannon bone with the pastern, or at the joint of the pastern with the coronet. If the exostosis should arise upon the body of the pastern or coronet bone instead of between the joints, this is known as false ringbone. The bones of the hind foot are more frequently the seat of ringbone, a disease which the reader will perceive is in the region of the fetlock.

*Navicular disease* is likewise associated with the foot. Behind the junction of the coronet with the coffin-bone is a curiously-shaped bone extending across from side to side. To this bone veterinarians have, as has already been stated, given the name of the navicular, though the bone so named by anatomists is in quite another region (the tarsus, or hock). The navicular bone is, as it were, boxed up between the coronet and the hoof; this bone is the seat of navicular disease, which, as it progresses, may spread to the tendon for bending the foot, which passes beneath the navicular bone.

Lastly, as to *spavin*, by which, presumably, bone-spavin is meant. The seat of this disorder is that region, halfway up the hind-leg, which is popularly termed the hock, and is called by anatomists the tarsus. There are six bones in the horse's hock, below which is the cannon



bone of the hind limb. The bone which projects backward on the outside is the calcaneum, below it is the cuboid. On the inner side of the lower part of the calcaneum, and partly in front of the latter, is the astragalus which presents upwards a beautiful pulley-like surface to form a hinge joint with the lower end of the leg-bone (the tibia). Below the astragalus is a flat, slightly curved bone, the true navicular of anatomists, but endowed with several other names by veterinarians (*e.g.*, scaphoid, cuneiform magnum, etc.). Below the true navicular again are two other bones, the cuneiforms (external and internal), resting upon the cannon-bone. In looking, from the front, at the hock of the off hind leg of the horse, the following arrangement shows approximately the relative positions of the six bones, though the internal cuneiform (or cuneiform parvum) is so far behind that it would not be visible:—



It will be seen that the bones of the hock are, as it were, “two deep,” on the outside, and “three deep” on the inside, regarded from above to below. Spavin is the name given to any exostosis, or bony outgrowth, in the region of the hock. It is usually situated at the inner and lower part of the region. Between and towards the front of the cuneiform bones is a common seat of the disorder. When spavins occur on the external faces of the bones they may easily be felt. If they occur between the hock-bones, however, there is little or no external indication, and the disorder is then known as occult spavin.

*Cataract* is an affection of the eye. This delicate and beautiful organ is constructed on practically the same principle as a photographer’s camera, for it contains, a short distance behind the pupil, a double-convex mass of transparent gelatinous material called the crystalline lens, the function of which is to focus images of external objects on a screen at the back of the eye. Any interference with the proper working of the crystalline lens results necessarily in imperfect vision, and, it may be, in blindness. The seat of true cataract is in this lens, or in the capsule which encloses it.

In order to adequately understand the changes accompanying diseases, it is obvious that some preliminary knowledge of the anatomy and physiology of the organs involved is desirable. In other words, it is necessary to know the normal structure and functions of organs in health before proceeding to study them when diseased.

It will be convenient here to indicate a few of the more important anatomical characters in which the ox, sheep, and pig *differ* from the horse.

**THE OX.**—The ribs are longer, wider, and flatter than in the horse. The sternum, or breast-bone, is flattened from above to below, and is not keel-like. The scapula is broader. Each cannon bone is formed of two equally developed metacarpals, or metatarsals (the 3rd and 4th) joined together by their inner faces, and at their ends are two distinct digits, which, with their horny coverings, form the "cloven" hoof. The skull is characterised by the extreme development of the frontal bone, which occupies the upper half of the face; it is remarkable for its thickness, and for the osseous conical cores which, in horned cattle, support the horns.

The horns consist of a bony core ensheathed in a strong horny epidermal case, the material composing which is secreted by a deep-lying membrane corresponding with the keratogenous membrane of the hoof. The bony core becomes hollow by the extension into it of the sinuses or cavities of the frontal bone, hence such horned ruminants (oxen, sheep, goats, antelopes) are classed as *Cavicornia* (hollow-horned). The horny sheath persists throughout life, growing with the bony core.<sup>1</sup> The horny covering grows like any other part of the epidermis, its cells being secreted by that portion of the skin which is spread over the osseous cores of the frontal bones, completely enveloping the latter. This skin is richly supplied with blood-vessels. The rings on the horn indicate the age, the first appearing after two years; as age advances they get obliterated from various causes. In the bull the horns are short, thick, and powerful; in the ox, large, long, and strong; in the cow, long and slender. In polled cattle the osseous outgrowths of the frontal bone have disappeared.<sup>2</sup>

In the horse, the lips are largely concerned in the prehension of food, and are very mobile. In the ox, the lips are far less active than the tongue, which latter seizes the herbage before it is bitten off. The tongue is rounder and more finely pointed than that of the horse; its roughness is due to conical papillæ pointing backwards and surrounded by horny sheaths. The patch on the upper lip between the nostrils, called the "muffle," or muzzle, is always humid in health; it is variously coloured, and pours out a thick yellowish glandular secretion.

The small intestine is about 150 feet in length, being twice as long and half as broad as that of the horse. The large intestine may attain as much as 40 feet in length; it is longer, therefore, than that of the horse, but its capacity, about 7 gallons, is much less. The liver is

<sup>1</sup> In the American Prong-horned Antelope the horny sheath is annually shed and replaced.

<sup>2</sup> In the Deer the frontal bones develop long *solid* outgrowths, which are at first covered by soft hairy integument ("velvet"), generally in the male only, but in both sexes in the Reindeer. These horns, or antlers, very rapidly attain their full size, and then a circular *burr* appears at a short distance from the root, dividing the horn into the proximal *pedicel* and the distal *beam*. The circulation of the blood in the beam now gradually ceases, its integument dies and peels off, and the dead bony substance is exposed. Absorption and sloughing take place at the end of the pedicel, and the beam and burr are shed. The extremity of the pedicel scabs over, fresh integument grows up beneath the scab, and eventually restores the smooth hairy covering. The development of horny matter into deer-horn is a very rapid process; as much as 72 lb. has been formed by one stag in ten weeks.

confined to the right diaphragmatic region, the gall-bladder being attached near its superior extremity.

The thorax is not so long as, and is less capacious than, in the horse. The lungs are noteworthy for the distinctness with which their lobules are defined, being separated by thick layers of tissue continuous with the pleura which covers the lungs. This accounts for the special character of the lesions accompanying pleuro-pneumonia in the ox.

**THE SHEEP.**—This animal resembles the ox in most of the essential characters. The lips, however, are thin, very mobile, and prehensile. The upper lip has no muffle, but is covered with hair, and is divided by a median groove or fissure. The mucous membrane lining the interior of the mouth is often spotted black. Like the ox, the sheep is a true ruminant, and it has the same kind of stomach as the ox.

**THE PIG.**—Of the domesticated animals this possesses the shortest, widest, and strongest cervical vertebræ. The skull has a pronounced occipital crest. At the free extremity of the median bone of the nose, a small floating bone, the pre-nasal ossicle or scooping bone, strengthens the cartilaginous snout. The *rostrum suis*, or snout, is a tactile organ employed to dig the ground, and is covered by a dark-coloured skin kept moist by a secretion. The articulation of the mandible is such that the jaw moves freely in all directions. The sternum is broad, like that of the ox. The second, third, fourth, and fifth metacarpals are all distinct, but the second and fifth digits do not reach the ground.

In the mouth, the lips are widely cleft, the lower being pointed and but little developed. The upper lip is confounded with the snout, and the cheeks are small and thin. Where the gullet enters the stomach, a groove extends in the direction of the exit from that organ. As this groove is well developed in ruminants, we have here a foreshadowing of the true ruminant stomach. The pig's stomach is less curved on itself than that of the horse, but, like the latter, it exhibits an internal differentiation into a functionless and a functional portion. Its capacity is from  $1\frac{1}{2}$  to 2 gallons.

The small intestine is about 56 feet long; the large intestine 16 feet. The liver has three well-marked lobes, the middle one supporting the gall-bladder. The urinary bladder is thin, and of considerable capacity as in ruminants.

**DENTITION.**—In the dentition, or tooth-furniture, of mammals there are two sets of teeth. The earlier set fall away in succession, and are gradually replaced by a later set, which come into place once for all. Hence, the former set constitute the temporary dentition, or, as they mostly appear when the animals are still sucking, the milk dentition. The later set constitute the permanent dentition. Every reader can recall the days of childhood, when the teeth became "loose," and, after being pulled out, were replaced by new ones. This, however, happens only once for each tooth concerned, and the anxious question sometimes

put by an adult to the dentist, as to whether a tooth just extracted will "grow again," is quite superfluous. In order to understand the names given to teeth, let the reader, if he has a tolerably sound set, look into his own mouth by means of a mirror. In the middle of the arcade he will see four biting teeth, two on either side of the middle line, above and below. These are the incisors. Flanking each of these four pairs, on the outside, is a conspicuous pointed tooth, the canine tooth, so that there are four canine teeth altogether. These are the "tushes" in the horse, and the "tusks" in the boar. Beyond, on each side, above and below, are five other teeth, the grinding teeth, or molars. They are characterised by the flat extended surfaces that meet in opposition, and serve to masticate the food. It is obvious that of these there are normally twenty, though as the last molar in the row, the "wisdom tooth," does not invariably come through, there may be as few as sixteen molars in the mouth of an adult man or woman. Of the thirty-two teeth which have been enumerated, it is seen, then, that eight are incisors, four are canines, and twenty are molars. But, of these, all the incisors, all the canines, and the first two molars on each side, above and below, are replaced, whilst the last three molars on each side above and below, come into position once for all. Hence the temporary or milk dentition of man comprises twenty teeth—eight incisors, four canines, and eight premolars, as the front molars are termed. This may be denoted by the following "dental formula":—

$$\begin{array}{ccc} \text{d.i. } \frac{2-2}{2-2} & \text{d.c. } \frac{1-1}{1-1} & \text{d.m. } \frac{2-2}{2-2} = 20 \end{array}$$

which means that there are two deciduous incisors on either side of the middle line, above and below, similarly there is one canine, and in like way there are two deciduous molars. All these give place to successors, and the permanent dentition, or adult dental formula, of man is—

$$\begin{array}{ccc} \text{i. } \frac{2-2}{2-2} & \text{c. } \frac{1-1}{1-1} & \text{p.m. } \frac{2-2}{2-2} & \text{m. } \frac{3-3}{3-3} = 32; \end{array}$$

where "p.m." denotes pre-molars (or successors of deciduous molars), and "m." molars.

It will now be easy to understand the dentition of the ox and the sheep, in both of which animals the dental formulæ are practically identical. The milk dentition is—

$$\begin{array}{ccc} \text{d.i. } \frac{0-0}{4-4} & & \text{p.m. } \frac{3-3}{3-3} = 20 \end{array}$$

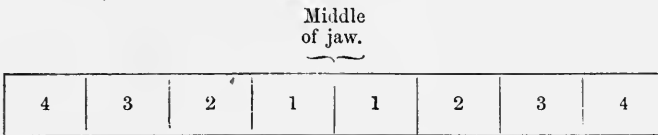
The permanent dentition is—

$$\begin{array}{ccc} \text{i. } \frac{0-0}{4-4} & \text{p.m. } \frac{3-3}{3-3} & \text{m. } \frac{3-3}{3-3} = 32 \end{array}$$

From the foregoing it will be understood that the ox and the sheep have no incisor teeth in the upper jaw, the faces of the premaxillary bones being covered instead with a thick cartilaginous pad against which the incisors in the lower jaw can bite. In the "full mouth" of the ox and sheep there are, as in the case of the horse (see Table on next page), six molars above and below, on each side, the front three of which have had predecessors. Sometimes, too, the insignificant little "wolf" tooth, which may occasionally be seen on the near side of the first of the six molars of the horse, is noticeable in the milk dentition of ruminants. An interesting question suggests itself as to why the horse should have only three incisors on each side of the middle line, above and below, and the ox and sheep should have four incisors on each side of the middle line of the lower jaw. The theory is that the fourth incisor on each side, or the "corner" incisor, is really a canine tooth, and, therefore, equivalent to the "tush" in a horse; but whereas in the horse there is a space between the tushes and the compact row of incisors (in the mare the tushes are usually absent), in oxen and sheep there is none. In his treatise, "A Manual of the Anatomy of Vertebrated Animals," Professor Huxley says of the Ruminantia, or animals that chew the cud:—"Canines may or may not exist in the upper jaw; they are always present in the lower jaw, and are generally inclined forwards and closely approximated to the incisors, which they usually resemble in form. It consequently happens that they are often reckoned as incisors, and Ruminants are said to possess eight cutting teeth in the lower jaw." In cattle and sheep, as in horses, there is a considerable space between the incisors and the molars. In the horse this space is called the "bar," and it affords room for the bit.

The subjoined diagram shows the relative positions of the incisors of the ox and sheep, and the nomenclature which follows will be readily understood.

DIAGRAM SHOWING POSITION OF INCISOR TEETH IN LOWER JAW OF CATTLE AND SHEEP.



1 1, 2 2, 3 3, 4 4, are the incisors.

1 1 are the central permanent incisors, or the centrals or pincers.

2 2 are the second pair of incisors, or the first intermediates or middles.

3 3 are the third pair of incisors, or the second intermediates or laterals.

4 4 are the fourth pair of incisors, or corners.

Sheep are named according to the stage of replacement of the incisor teeth. When the permanent centrals (1, 1) appear the animal is a "two-teeth" sheep; when the permanent middles (2, 2) appear it is a

four teeth" sheep; when the permanent laterals (3, 3) appear the animal is a "six-teeth," and when the permanent corners (4, 4) appear the sheep is said to be "full-mouthed."

The teeth of the horse are referred to in a subsequent chapter (page 437), but the reader will have no difficulty, after what has been said, in understanding the subjoined statement:—

TABLE SHOWING ADULT DENTITION.

	Incisors.	Canines.	Pre-molars.	Molars.	Total.
Man . . .	$\left\{ \begin{array}{l} 2-2 \\ 2-2 \end{array} \right.$	$\left\{ \begin{array}{l} 1-1 \\ 1-1 \end{array} \right.$	$\left\{ \begin{array}{l} 2-2 \\ 2-2 \end{array} \right.$	$\left\{ \begin{array}{l} 3-3 \\ 3-3 \end{array} \right.$	32
Horse . . .	$\left\{ \begin{array}{l} 3-3 \\ 3-3 \end{array} \right.$	$\left\{ \begin{array}{l} 1-1 \\ 1-1 \end{array} \right.$	$\left\{ \begin{array}{l} 4-4^1 \\ 4-4 \end{array} \right.$	$\left\{ \begin{array}{l} 3-3 \\ 3-3 \end{array} \right.$	44 <sup>1</sup>
Ox . . . } Sheep . . . }	$\left\{ \begin{array}{l} 0-0 \\ 4-4 \end{array} \right.$	...	$\left\{ \begin{array}{l} 3-3 \\ 3-3 \end{array} \right.$	$\left\{ \begin{array}{l} 3-3 \\ 3-3 \end{array} \right.$	32
Pig . . .	$\left\{ \begin{array}{l} 3-3 \\ 3-3 \end{array} \right.$	$\left\{ \begin{array}{l} 1-1 \\ 1-1 \end{array} \right.$	$\left\{ \begin{array}{l} 3-3 \\ 3-3 \end{array} \right.$	$\left\{ \begin{array}{l} 3-3 \\ 3-3 \end{array} \right.$	40
Dog . . .	$\left\{ \begin{array}{l} 3-3 \\ 3-3 \end{array} \right.$	$\left\{ \begin{array}{l} 1-1 \\ 1-1 \end{array} \right.$	$\left\{ \begin{array}{l} 4-4 \\ 4-4 \end{array} \right.$	$\left\{ \begin{array}{l} 2-2 \\ 3-3 \end{array} \right.$	42

THE VERTEBRAL COLUMN.—In the brief notes that have been given on the anatomy of the ox, sheep, and pig, no reference is made to the divisions of the vertebral column: the information is, therefore, included in the following tabular statement:—

TABLE SHOWING THE NUMBER OF VERTEBRÆ IN THE SEVERAL REGIONS OF THE SPINE.

	Cervical.	Thoracic or Dorsal.	Lumbar.	Sacral.	Caudal.
Man . . .	7	12 $\left\{ \begin{array}{l} 7 \text{ true ribs} \\ 5 \text{ false ,,} \end{array} \right.$	5	5	4 or 5 (coccygeal)
Horse . . .	7	18 $\left\{ \begin{array}{l} 8 \text{ true ribs} \\ 10 \text{ false ,,} \end{array} \right.$	6	5	About 17
Ox . . .	7	13 $\left\{ \begin{array}{l} 8 \text{ true ribs} \\ 5 \text{ false ,,} \end{array} \right.$	6	5	16 to 20 <sup>2</sup>
Sheep . . .	7	13 $\left\{ \begin{array}{l} 8 \text{ true ribs} \\ 5 \text{ false ,,} \end{array} \right.$	6 or 7	4	16 to 24
Pig . . .	7	14 $\left\{ \begin{array}{l} 7 \text{ true ribs} \\ 7 \text{ false ,,} \end{array} \right.$	6 or 7	4	21 to 23
Dog . . .	7	13 $\left\{ \begin{array}{l} 9 \text{ true ribs} \\ 4 \text{ false ,,} \end{array} \right.$	7	3	16 to 21

<sup>1</sup> These include the four "wolf's teeth," which are insignificant and often absent. Hence, the effective total in the horse is 40.

<sup>2</sup> The bones found in ox-tail soup are caudal vertebræ.

The reader will find further information on the subjects dealt with in this chapter in three illustrated pamphlets, written by Professor Sir George Brown, C.B., for the Royal Agricultural Society, and published by Mr. John Murray, Albemarle Street, London. They are "Animals of the Farm in Health and Disease" (1s.), "Dentition as Indicative of the Age of the Animals of the Farm" (1s.), "The Structure of the Horse's Foot and the Principles of Shoeing" (6d.).

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## CHAPTER III.

### ON BREEDING HORSES.

THE *breeding of horses*, as a distinct concern, can be carried on with success on those farms containing tracts of coarse pasturage, which cannot be advantageously appropriated to the fattening or grazing of other animals. Of this description are part of the North Riding of Yorkshire, the fens in the county of Lincoln, the pastures of Leicestershire, and some of the midland counties. In the horse-breeding districts of the fens much of the land is, however, of very good grazing quality, and the better the turf the better the horses. The same attention must be paid to symmetry of form, purity of blood, and individual excellence, as in the breeding of cattle. It is unnecessary to repeat that which has already been said of the principles of breeding generally, but it must never be forgotten that in every species of animal, and including both the male and the female, "like produces like." If they are not incompatible, the form and the qualities of both the parents will descend to the offspring; and it is from the care with which animals of different sexes are selected, generation after generation, possessing certain excellences and certain predispositions, that these results, in process of time, become the distinguishing characteristics of definite breeds.

From this arises another circumstance that should always be borne in mind,—opposite qualities in the parents are to a certain degree neutralised in the offspring. If a large heavy horse covers a small light mare, the offspring will be lighter than the sire and heavier than the dam. Thus we have the power of remedying many serious faults in the one and the other. Let it therefore be remembered that the entire attention should not, as is too commonly the case, be confined to the stallion: without going so far as to say that as much depends upon the mare as upon the horse, in regard to the form and other good qualities of the progeny, we would impress on everyone the fallacy of breeding from a mare that is good for nothing else. The weaknesses, vices, or diseases of such an one are sure to be inherited by her offspring. No

idea can be more erroneous either, than the too common one of breeding a good hunter from a blood-stallion and a cart-mare ; nor can anything be more ridiculous than to suppose that the qualities of each will be so equally blended in their offspring as to constitute a happy medium between both, thus producing a colt in which the speed and liveliness of the sire shall be combined with the strength and endurance of the dam. On the contrary, we shall see a perceptible degeneracy in these respects ; the mongrel breed rarely possessing in any considerable degree the power or size of the one, or the spirit, activity, and fine bone of the other, but rather exaggerating the defects of both parents.

It frequently occurs that horses, as well as other domesticated animals, *breed back*, not to the sire and dam, but to some remote ancestor of the stock, by which accident some old defect, that was supposed to have been got rid of, is unexpectedly revived. This, which is known as atavism, is more commonly observable in breeds that have been crossed than in those in which the original blood has been preserved pure. It is therefore advisable, when the mare has any good points, to select a stallion as similar as possible in form, for then it will be probable that the foal will possess them in still greater perfection.

The horses passing under the denomination of hunters, and the common crosses for roadsters and hacks, can by no means prove so generally profitable to the breeders as when they confine themselves to one particular stock. When all contingencies are taken into consideration,—the length of time the colts are obliged to be kept on hand and maintained—the unavoidable difficulties and dangers of the serious operations of cutting, breaking, backing, docking, and nicking, and the fickleness of taste in purchasers, where as much depends on appearance as real merit,—this branch of breeding must be attended with much uncertainty. Independently of these general considerations, it must be borne in mind that different counties differ much in the circumstances that render breeding profitable;<sup>1</sup> and that in many, horses of size, and other desirable qualities, cannot be produced without incurring an expense amounting to more than their real value. Therefore, our advice is, breed animals best adapted to the locality they are destined for, and breed from the soundest and best you can command.

A brood mare having been obtained, corresponding in size, frame, bone, and strength with the ideas of the breeder, and found, upon careful examination, to be perfectly free from natural blemishes and defects, the choice of a stallion becomes an object of attention. In him should centre all the points and qualities that it is possible for a good horse to possess ; for, notwithstanding the influence of the mare on the constitution and nervous system generally, the produce, whether male or female, much more frequently acquires and retains the shape, make, marks, and external conformation of the sire than of the dam. This justifies us in rejecting stallions with the slightest appearance of

<sup>1</sup> See John Sebright's Essay on the Improvement of the Breeds of Domestic Animals, pp. 11 to 14 ; and Communications to the Board of Agriculture, vol. ii., p. 185.



disease, blemish, or bodily defect: at least if there is the most remote probability of its being transmitted to the offspring. It is even necessary to descend to such minute details as the symmetry of the head, neck, shoulder, forehead, ribs, back, loins, joints, and pasterns, as well as a strict uniformity in the shape, make, and texture of the hoofs; and, if possible, even the temper and disposition should be ascertained. It is also proper to examine the state of the wind, and to endeavour to discover whether there is any tendency to spavins, curbs, cracks, grease, corns, thrush, bad conformation of the feet, or long and narrow-heeled hoofs. Any of these should furnish sufficient objections against him for breeding purposes, however commendable he might be in other respects.

Blind stallions may sometimes get colts with good eyes, yet breeding from them had better be avoided, as a hazardous experiment. A well-informed writer in the *Pantologia* states that, in the year 1773 or 1774, a great number of brood mares in his neighbourhood were covered by a favourite blind stallion, belonging to the Honourable F. King, near Ripley, in Surrey, whose pedigree, shape, make, figure, and qualifications were so perfect, that the want of eyes scarcely seemed to constitute an objection. The result, however, was, that, about the third or fourth year, the major part of the colts got by this stallion had become as blind as their sire.

Anxious to ascertain the truth and extent of this hereditary transmission of disease, Mr. Taplin bought a grey horse, called Jerry Sneak, that had proved a tolerable runner while in the possession of Lord Spencer Hamilton; and whose eyes were just beginning to fail. This horse covered a few mares in the neighbourhood of Frimley, near Bagshot; but it was found, in the fourth year, that most of the produce were totally blind, and the remainder very likely to become so. The fact, indeed, of the transmission of constitutional defects from both sire and dam has been so fully established by frequent experiments as to require no further corroboration; nor does it apply to blindness alone.

On the subject of *crosses* there are various opinions. It was said by the greatest breeder in this country, Mr. Bakewell, and deduced from long and attentive experience, "that to cross with a breed not decidedly better than the other should never be attempted; but, if a superior breed could be obtained, it was a truly desirable measure." In these sentiments he was joined by the late Mr. Campbell, of Charlton, also an excellent judge, who thus expresses himself in some letters on the subject addressed to Lord Egremont:—"As to the art and mystery of generation, or conception, all that I pretend to know—and that I do, by many experiments, to a certainty know—is, that ill shapes and properties of a particular breed, when introduced into others, even by a single cross, will continue to have effect, sometimes more, sometimes less, and sometimes lurking for generations, scarce perceivable, or even totally out of sight or feeling, and then break out in some individual as strongly, and with as bad effect, as if there had never been any further mixture or addition of blood on the other side. I therefore consider

crosses to be a matter requiring the greatest caution, and what I should never choose to resort to, if there was one bad property in the proposed cross; and I am of opinion that the surest and best means of improving a breed, is by constantly and completely weeding the original stock and nursery, and securing the opportunity of advantage from particular extra individuals that may happen to be produced in it; and in every respect availing one's self of all the use it may afford, and carefully preserving the continuance of it as long as possible, or until a yet better comes."

The judicious breeder will observe, however, that this does not authorise the system of *breeding-in-and-in* so far as to weaken the original stock, which it undoubtedly will do, if long persevered in; but it only requires that it should be confined to the most perfect animals of the same *breed*, although not of the same *stock*. The advocates of that practice maintain "that best can only procure best; and therefore, when we cannot procure a better animal than our own, we should breed from that." Repeated trials, however, have proved that animals of all kinds so produced—that is to say, bred from a continuation of the same race—degenerate in size and vigour, and also perpetuate those defects, some of which are found in every breed; therefore, after a couple of descents from the same family, it is always advisable to cross the mares with a stallion from another stock. There has been much discussion as to the principles which regulate the breeding of animals, but space does not permit of our going into the various points further than we have already done. We may, however, conclude our remarks in this department, by quoting here the conclusions arrived at by Dr. Hitchman, the author of an able paper on "Breeding and Form of Stock:"—

"1. That man has been endowed with the means of controlling and modifying the forms of all animals.

"2. That such modified forms can be handed down to the progeny; but, being departures from the primitive or natural type, the form can only be maintained by assiduous attention on the part of the breeder.

"3. That not only because the qualities of the male can be immediately brought to bear upon larger numbers, but also because of his own special endowments, it is best to seek for improvement of form and quality through him.

"4. That qualities both of the form and also of the character become hereditary in proportion to the frequency of the repetition in past generations, but that it is dangerous to breed from any animal with important defects, however high its pedigree.

"5. That healthful well-formed animals, without hereditary taint, even if closely related, may be safely permitted to propagate their kind, provided the practice be not continued through many generations.

"6. That young animals, for their first impregnation, should be placed to the best of their own kind, in order to avoid the reappearance of stain in any future progeny.

"7. That science has not revealed any trustworthy arrangement

by which the proportion of the sexes can be determined upon and secured."

The lack of success in horse-breeding, writes Sir Walter Gilbey, in the "Live Stock Journal Almanac," is attributable to a great extent to the want of care in the selection of the dam. Many persons possessing mares, regardless of their loose, leggy make, small size, or hereditary unsoundness, have thought them good enough to breed from. To those who have such mares, the advice given on other occasions may be repeated, "Do not breed from the old mare because she is an old mare, and although she may be a favourite." The breeding of any species of animal with a view to obtaining any one quality, while it leads to greater perfection therein, is often accompanied by deterioration in other respects. Such has been the consequence of aiming chiefly at speed—by which size, shape, action, and strength have been to a great extent lost sight of. The sire acts the principal part in impressing his character and moulding the outward form of the offspring, whilst the dam has her influence over the internal organs and vital functions of her produce. That which is really wanted, therefore, is the judicious blending of the qualities of the Thoroughbred stallion with suitable half-bred mares and light draught mares.

A horse, for riding or driving, may be good, so far as being strong and useful, but to be valuable he must be good-looking, have a graceful carriage, and be true in his paces; therefore, to breed such animals, the sire and dam should be selected with the idea in mind that good-looking, sound, strong, active, safe-stepping horses mean "good prices." Those who disregard imperfections in the sire and dam will not be successful in making horse-breeding, as an adjunct to their other business, remunerative. The ill-digested notion is happily now fast being dispelled, that the services of any weedy, useless blood sire may be accepted because his travelling fee is small.

Sir Walter Gilbey gives the following practical suggestions as to the standard or type of stallions and mares to breed from.

**THE STALLION.**—All pure-bred sires are better suited for getting half-bred stock. He should be Thoroughbred, and, if possible, a proved good stock getter. Racing qualities do not always prove suitability for stud purposes.

*Soundness.* He should be free from hereditary unsoundness. He should possess a good and not fretful temper.

*Colour.* Bay or brown.

*Height,* 15·2, and in no case to exceed 15·3.

*Head,* not too large, to be well set on.

*Neck* fine, arch-looking where it joins the head, and on no account to be ewe-necked.

*Shoulders* to be sloping, with breadth at the withers, not sharp (knife-shaped).

*Chest* fairly capacious, as the size and shape govern the condition of the lungs. Depth of chest is necessary for speed.

*Back* to be straight and rather short, with breadth across the loins.

Neither a hollow nor yet a roach-back. Girth to be deep, well ribbed up, and not too flat.

*Hind-quarters* to be full, and there must be length in every part of the hind-quarters where the muscles are located. Not sloping hind-quarters or goose-rumped.

*Tail* to be well set on, high, and no inclination to either side.

*Legs.* Fore-legs should drop straight from shoulder to ground, knees not set-back (calf-kneed). The elbow should neither be set out nor in, a defect either way prevents true action.

*Hind-legs.* The bones of the hock should be large, well-formed, and clean—free from enlargement or puffs of every kind. Should stand square on all four legs. Neither leg to be twisted.

*Fetlocks* to be sloping; not too long, and not turned either outwards or inwards.

*Feet* to be good and open, with no pretension to smallness or contraction.

*Action.* He should be able to walk, trot, and gallop freely; the action should be true and straightforward; not pigeon-toed or dished.

**THE MARE.**—Many of the suggestions given under the head of the stallion are applicable to the mare; the maxim "like begets like" is therefore worth remembering in selecting either sire or dam.

There are no mares so valuable as those which throw their foals after the sire, and tried brood-mares that have proved matrons of good stock. It is no criterion of a mare's suitability that she is highly bred or a clever hunter.

The *Half-bred* or *Hunting Mare* should have a good constitution, be symmetrical and good-looking. Height from 15·2 to 16 hands—roomy, compact, deep-bodied; not leggy, loose, slack, or narrow.

A mare can be put to the stud from two years to eight years old.

Mr. Armstrong suggests the following procedure for breeding what will eventually be called pure-bred hunters. Select 14-stone blood-like hunting mares—either Thoroughbred or nearly so—put them to horses like Silver Crown, Truefit, Blue Grass, Blue Blood, Ruddigore, Suleiman, Rosnal, Knight Templar (all winners of Queen's Premiums), or other strong horses, and then select the best of the resulting fillies and colts, and put unrelated ones together to breed hunters. Again select in like manner from the youngsters, and there will gradually be developed a stronger and sounder animal than the racehorse, but not quite so speedy. Even the comparative failures will pay the cost, and the successes will leave a good profit.

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## CHAPTER IV.

## OF CART STALLIONS AND MARES.

IN our observations on breeding, we have already considered so fully the requisite qualifications of horses intended to propagate their respective breeds, that it only remains to particularise the points that are peculiar to our heavy draught horses of various descriptions.

The *cart stallion* should possess all the properties of vigour and constitution, strength of muscle, and just proportion of bone, which other breeds have; but there are certain points considered essential to the symmetry of one breed of horse, that may be and are deemed imperfections in another. Thus, one of the most important points in a hunter, and more especially in a good hack, is, that he be high in the fore-hand, with a shoulder thrown back, so that the saddle may rest behind his fore-legs, and the weight of the rider may not impede his action. In the English draught horse, the shoulder can scarcely stand too upright, so that the collar may bear equally upon it, without pressing too much on the withers. A low fore-hand is here found advantageous, inasmuch as it brings the traces more upon a level with the line of draught. Thus, also, the small head, the expanded nostril, and the fiery eye, so much admired in blood horses, are indications of spirit and impatience very ill suited to an animal that is required to obey the voice of the driver, and whose steadiness is one of its greatest merits. The cart stallion should undoubtedly have a moderately large head, with a full but placid eye, a muscular neck, a broad, deep chest, and an upright shoulder. His back should be broad, and rather short, and somewhat curved upwards over the loins, that being a sure sign of strength. His barrel should be round and deep, and well ribbed up to the haunch-bones, which should never stand prominently out. His quarters and thighs should be thick, the arms sinewy and strong, the legs short, and the hoofs round, but wide at the heels, and of a dark appearance and tough substance. His colour must depend upon the breed, and although it has often been remarked that "a good horse is never of a bad colour," yet the darkest are generally found to be the hardiest. Blacks are proverbially steady pullers; and experience has proved that they and the greys are less subject to become blind. His size is a most material consideration, for, even in the heaviest breeds, very large bones are not always an indication of proportionate strength;  $16\frac{1}{2}$  hands should be the least of his height, and he should look smaller than he really is: a horse that looks his full size, or larger, is seldom symmetrically formed. Compactness is better adapted to hard work and lasting spirit, and it should be remembered that the greatest improvements in our stock of blood horses have been effected by the smaller breeds of Barbary and Arabia.

In the admirable essay which Mr. Richard S. Reynolds contributed

to the second volume of the English Cart-Horse Stud-Book (subsequently the Shire Horse Stud-Book), we read that the offspring of equally well-bred parents will more closely resemble the progenitor nearest in age to the prime of life, and possessing the most vigorous constitution. In the absence of influencing conditions the progeny, if a colt will favour the stallion, if a filly the mare. That the influence of the sire does not terminate with the birth of the first offspring is proved by frequent facts in dog-breeding, and in more than one instance in the mare; hence the great importance of fillies getting their first service from a good, sound, well-coloured horse. For the conservation of any particular type the males should be more representative than the females, for whilst a mare produces one foal only in a year, a stallion may be the sire of seventy or eighty foals.

In the selection of stallion and mare for breeding draught horses, primary attention must be given to capacity of chest, a full development being usually associated with a wide lower jaw, massive forehead, and capacious nostrils. The ribs should be well rounded and deep, withers thick and strong, shoulders massive, and well thrown outwards to afford ample space for the collar; eyes large, clear, full, and expressive of docility and intelligence; ears well formed and mobile; the loins short, wide, and level with the croup, which should be long; the thighs well let down, and furnished like the reins and buttocks, with large and firm muscular developments; the fore-arm and second thighs constituted of distinct and very tense muscle; the knees and hocks large, well defined, and possessing great mobility; tendons and ligaments thick, and equal throughout their length; the feet strong, hard, neither too flat nor too upright, and in size proportionate to the bulk of the animal; cannons, fore and hind, short, measuring not less than eleven inches in circumference immediately below the knee, and garnished with a plentiful growth of hair. With regard to position, the limbs should be so placed that each extremity, and each bone thereof, shall support its due proportion of weight.

Moderate condition, attained by good food associated with regular and sufficient labour, is desirable in breeding-animals. Excessive leanness implies irritability of temper, or the existence of disease, whilst a disposition to put on fat indicates a soft lymphatic temperament, either of which extremes is unfavourable to the best fulfilment of the reproductive functions. Other qualifications—action, courage, vigour, capacity for work, intelligence, and obedience—are also desirable in stud animals.

In selecting a stallion it is not so much the animal himself, as the quality of the stock already got by him, that should be considered. As a rule the number of mares assigned to a horse in this country is excessive. It is common to allow two-year-old colts to be pretty extensively used, but the most considerate owners limit the number of their services for the first and second seasons. The excessive use of young stallions is detrimental to their development, and the effect upon their hind legs is often disastrous. The stimulating diet they get also tends to debilitate their constitutions, and to lay the foundation of irremedi-

able diseases. Entire horses, which have not been forced by strong food, and have been but moderately used up to five years old, remain sound and vigorous to a good old age, and to a sound, hardy stallion of from seven to fifteen, or even more, years, possessing suitable qualifications, breeders may be recommended who desire good, strong, healthy foals.

A practice, much adopted on the Continent, of allowing the mare to be covered twice within a comparatively brief period, has much to recommend it, but with travelling sires it is attended with inconvenience. Still, if followed by successful results, it is better for the horse to serve the mare twice in one day than to cover her, if refractory, four, five, or even more times, at intervals of several days. Sometimes it happens that a stallion, especially a young and over-used one, is insensible to the attractions of a mare, and more markedly so if she is suckling at the time. When an antipathy of this kind obstructs what appears to be a desirable alliance, the practice is adopted of exciting the horse by the approach of another mare, and, at the moment of service, substituting the one it is wished should be covered. The deception often proves effectual, but its frequent repetition has the almost certain effect of rendering a docile horse savage and ill-tempered.

It is generally admitted that working stallions beget more foals than those whose systems have been pampered by over-feeding and insufficient exercise. During the season, travelling stallions cannot, of course, be put to team labour, but they should have sufficient daily exercise to maintain their locomotory muscles in vigour, to create a natural appetite for food, and to receive the full benefits of pure air and change of scene.

During the season stallions should be well dieted, nor should their condition be too greatly reduced out of season. Still, every tendency to obesity must be checked, both by controlling the food and by exacting more labour. Oats and hay make the best provender, with an addition in season of beans and peas for stallions of five years and upwards. When the season is over the beans should be stopped, the oats reduced in quantity, and boiled barley substituted. Whenever good grass or tares can be got, they should be given, and, as an alternative, pulped roots and chaff. Wheat should never be used, for it predisposes to attacks of laminitis and other congestive diseases. Mr. Reynolds adds that the administration of aphrodisiac agents—drugs employed to increase eagerness for service—should be rigorously discouraged.

The material difference between the form of a brood mare and of a stallion is, that she should be rather the longer in the body, with the head, neck, and forehead less massive, the croup and thighs larger, and the abdomen and pelvis relatively more capacious than the corresponding regions in the stallion. The *cart-mare*, however, should have a long body, roomy chest, broad loins, and wide quarters, a good head well set on, and well formed and well placed legs. Her constitution should be healthy and vigorous, her temper gentle and tractable, her generative organs and mammary glands should be well developed, and she should be free from all hereditary defects.

A filly may be served at two years old, though this is scarcely wise. The best age at which to put a mare to the horse is three years old, so that when she is sold in the autumn of her seventh year, the owner will probably have obtained two foals, the value of which, added to the earnings of the mare as a team animal, will leave her full sale price as the proprietor's profit. For a working mare, it is better to defer her going to hard work until the third or fourth year, so as not to try her strength too early. Mares that have no hard work may produce a foal every year; but once in two years is often enough for those who work. The alliance of strong young mares with aged and robust stallions is the most certain method of obtaining a yearly production of good foals. Mares that have been worked up to ten or twelve years old in towns, and are required at that age for breeding purposes, seldom fulfil expectations; by the maintenance of high condition for a prolonged period they are rendered prone to sterility, and, if fecundated, they are apt to experience difficulties in labour.

The *period of gestation* in mares is about eleven calendar months,<sup>1</sup> and the time of putting them to the horse, when the progeny is destined for agricultural purposes, is usually in April or May. The former month is preferred by many persons, from an idea that the earlier the foals are dropped in the ensuing spring, the better chance they will have of thriving, in consequence of being suckled longer before it becomes necessary to wean them, though when they are dropped at this season, it is often so cold that their growth is stunted; nor is the herbage either sufficiently abundant or rich to afford the necessary supply of milk to the dam. It is therefore an injudicious practice, unless the mares are well supplied with succulent food in addition to their pasture, and have also the advantage of warm sheds to run into at pleasure. It is even less advisable for mares that are employed in farm labour, for if they are covered early, they will drop their foals at the busiest season of the year. As a matter of practice mares rarely foal outside, nor are they turned out until there is sufficient food. The month of May is the preferable time, for the mares will then foal after the spring sowing, at a period when there will be grass, and, soon afterwards, winter tares for their support, with time for them to rest before their services will be again needed for turnip sowing and hay harvest, though this period of rest is less prolonged than was the case in former days. The mares having dropped their foals, the best time of putting them to the horse again is about a month afterwards, when they will generally be found in season.

If the progeny is intended for hunting or racing, the mare is, if possible, covered in the early part of February or March, for as the age

<sup>1</sup> The result of the experiments made by M. Teissier on the gestation of mares is as follows:—

Of 278 mares,	23	foaled between the	322nd	and	330th	day :	mean	term,	326	days.
	227		330th	„	359th		„	344½	„	
	28		361st	„	419th		„	390	„	

There was, therefore, between the longest and shortest periods, an interval of ninety-seven days.



of the horse now legally dates from the first of January, a late-dropped foal might often be said to have entered his second, or any subsequent year, and be compelled to carry weight accordingly, when he really was two or three months short of that age.

Mares should be well- but not over-fed throughout the whole period of gestation. Grass, unaided by artificial food is, observes Mr. Reynolds, insufficient for the sustenance of breeding mares who are also at work; to insure the yearly production of strong foals a daily allowance of corn should be continuously given them, but, except in the depth of winter, or for very young or very aged mares, green food, chaff, and pulped roots suffice for the requirements of non-workers. Mashers or bruised oats or barley, associated with pulped roots and chopped hay or straw, moistened with linseed-cake water, are the most suitable foods for working mares in foal. Maize is not a desirable article of diet for in-foal mares when it constitutes a chief part of their corn allowance—their newly dropped offspring always exhibit general weakness of muscle and abnormal relaxation of the ligaments of the joints. Every description of food likely to undergo rapid fermentation, or to produce indigestion, must be scrupulously avoided. Long fasts are extremely prejudicial.

The Yorkshire farmers who breed from their working mares, generally employ them until the very time of foaling (and where the work is not too heavy this practice is advantageous rather than otherwise), after which they usually have two or three weeks' rest before they are again put to labour. The foal, while very young, is shut up in a stable during the time its dam is working; but this should not be continued, for exercise, in moderation, tends to develop its frame and invigorate its constitution. It is the practice of some farmers to bathe the udder of the dam with lukewarm water when she returns from work, and to draw some of the milk, lest, in consequence of its being heated, it should have a bad effect upon the foal. This is a good plan, so far as regards the washing of the udder, for that refreshes the dam; but the waste of the milk is objectionable, and it is better to allow the mare to stand until she is cool. Some continue to separate the foal from the dam so long as the former sucks; others, after it has acquired sufficient strength to run with the mare, allow it to accompany her at her labour on the farm, from an opinion that it is of advantage to both that the milk should be frequently drawn,<sup>1</sup> while the exercise that the foal is thus compelled to take contributes to its growth and strength; and in this latter opinion we coincide.

In districts where the mare is not required to work until the foal is weaned, grass suffices for all her requirements. The best old pastures should, however, be reserved for her use. When, through drought or overstocking, these cease to afford sufficient green food, the deficiency must be made up by an allowance of cut artificial grasses, lucerne or clover, given with discretion.

The usual time for weaning is when the foal has reached the age of

<sup>1</sup> Agricultural Survey of Yorkshire, p. 275.

five or six months. Mares should be partly placed on hard meat a few days before the weaning of the foal, and entirely so immediately after their separation, for it assists in drying off the milk, and, if mares are again in foal, it is of service in strengthening them, and in preventing abortion—an accident which is not uncommon at that time. Care, however, should be taken to keep their bowels open during this period, for which purpose either bran mashes should be given nightly, or they should be turned into a paddock. The latter is the better practice, for the less mares in foal are kept in the stable the better, and open sheds are at all times preferable. It is desirable that the mare should at this period be more severely worked.

As we have already observed, moderate work, so far from being prejudicial to mares while they are in foal, is of service; it promotes health and vigour, and enables them to produce their young with greater ease, and it may be continued with safety until the near approach of their foaling is announced,—first, by the springing of the udder, and soon afterwards by the teats becoming filled with milk.

Mr. Archibald Macneilage, in his instructive essay<sup>1</sup> on the systems of management in breeding studs of draught-horses, notes the fact that the amount of rainfall in a district is a matter of considerable importance to horse-breeders. He describes the management of brood-mares according as they (1) are kept solely for breeding purposes; (2), do an ordinary share of farm labour; and (3), are kept for breeding and exhibition. At the most extensive breeding stud in Scotland, that at Keir, Perthshire, the feeding is of the lightest description, the allowance per head being 1 bushel of oats per week, mixed with chopped oat-straw, a few Swedish turnips in the forenoon, a pailful of boiled meat—turnips, cut hay, and bran—in the afternoon, and oat-straw *ad libitum*.

At Balmedie, Aberdeenshire, about half a dozen mares are kept solely for breeding. During winter they run at grass all day, but are housed at night. They are fed thrice daily—at 5 A.M. and 4 P.M. with boiled mash, and at 8 P.M. with hard feeding, consisting of about 1 lb. of oats to each, mixed with one turnip, and enough cut hay to fill a 2-gallon pail, with abundance of fresh oat-straw for fodder.

At Montrave, Fifeshire, the brood mares number fifteen, of which seven are kept solely for breeding purposes. As a rule, even in the worst weather they prefer to lie out rather than in the sheds which are provided. During winter the mares are fed twice daily with bruised oats and chopped hay, and a few raw Swedish turnips. The daily allowance is about 14 lb. of the mixed food per head, one half being given in the morning, and the other in the evening, during the period from the end of September until the grass comes in spring.

Mares kept solely for breeding are apt to be somewhat neglected as to care of their feet and legs, because, not being required either for work or show, they are taken little notice of, except when in season

<sup>1</sup> Transactions of the Highland and Agricultural Society of Scotland, 1890.

and about the time of foaling; whilst, however, there is no occasion to have these mares shod, their feet should have careful attention and be dressed at regular intervals, care being taken to prevent the hoof breaking. The toes should be kept short, and the hoof of a round open shape, and the pressure brought to bear on the frog and heel. In this way the hoof-head is kept open and round and the heel wide,—two of the most important characteristics of a sound foot.

Mares kept both for work and breeding make up by far the most numerous class in Scotland. Absolute unanimity appears to prevail amongst breeders to the effect that mares in foal should be carefully worked in cart-yoke at all times, should not be “backed,” and for two or three months before foaling should only be worked in plough, and more and more leisurely and carefully as the foaling-time draws near. There is equally general agreement that mares thus carefully handled have usually the easiest foaling-time, and the strongest, most thriving, and healthiest foals.

The management followed at the Linkwood stud, Elgin, affords a good general description of the treatment of mares kept both for work and breeding. The ordinary rations for work-mares in foal are 168 lb. bruised oats per pair per week, with a small allowance of Swedish turnips, and hay *ad libitum*. A small dose of Epsom salts, about 2 oz. each, is given occasionally on a Saturday night. As some mares are at best but poor nurses, their food may be so modified as to greatly influence the yield of milk. At Balmedie, mares that foal early and have little nourishment for their offspring are generally fed on sloppy food, consisting of boiled barley, oats, turnips, and cut hay, mixed with some meal. Bran is considered specially valuable for this purpose, and should never be omitted. The quantity recommended for one meal is: 1 lb. oats,  $\frac{1}{2}$  lb. barley, 1 lb. bran, 1 lb. bruised oats, and 1 lb. cut hay and straw, with a few turnips, and a little salt and treacle, three times a day.

There are, however, mares whose milk is alike plentiful and strong, causing diarrhoea in the young foal. This is an evil to be guarded against, and it is found useful in such a case to put the mare on dry food and straw fodder; and if at grass, she is put on to the oldest, where it is least succulent, and sometimes it may be advisable to draw off some of the milk by hand. These cases are, however, comparatively rare.

The Radley stud, Berkshire, comprises 16 mares, and all are regularly worked till within a fortnight of foaling; but for a month previous to that they get the lightest part of the work, and are never allowed to be put between shafts from the moment they are seen to be with foal. After foaling they are fed with chaff, bran, and a few oats, until the foals are strong enough to lie out. The reason of this is, of course, that the foaling season is much earlier in England than in Scotland; and hence, no doubt, in some measure, the earlier maturity of English-bred horses.

Before concluding our remarks on the breeding of horses, as contained in this and the preceding chapter, a few notes on some

other points of practical importance must be given. We have already, in the Book on Cattle, pointed out the importance of attending to the proper selection of first-class bulls where stock of value is desired. If this is important as regards cattle, it is not of less importance in the case of horses, upon whose quick and economical working so much on a farm depends. Although more attention is paid to the breeding of horses, both from good sires and dams than formerly, it is notwithstanding matter of great surprise to those who are closely interested in the progress of agriculture in this country, to note the extraordinary indifference there is amongst farmers as to having a good stock of working horses. At one time any old "screw" of a skeleton was deemed good enough to serve a mare with, although, as sometimes happened, she was of a good or moderately good breed; and even to this day many are still content to carry on the system, which is as silly as it is a source of serious loss to them. As a writer, from whom we shall presently quote a most suggestive paragraph, remarks: "Farmers forget that the cost of 'serving' is a small item compared with the sum spent in the after rearing and training of the animals." The difference, moreover, between the sum asked for the services of a sire with good points and a fair pedigree, and that for those of an "old worthless screw" is so very trifling compared with the increased, or rather greater value of the superior progeny obtained by the use of the good sire, that no one, unless he is enamoured of the "penny wise and pound foolish" system would ever think of withholding the amount of the difference.

While "pedigree" must not be overlooked or neglected as constituting an important element in estimating the value of the sire as a stock-getter, so much should not be made of it as to override or put out of consideration in the mind of the breeder the necessity of attending to the "points" of the animal; to ascertain which the breeder must subject it to a rigid examination. It is but a common-sense proceeding to see what we are paying our money for. The writer to whom we have already drawn attention, while commenting on the subject of pedigree, and contrasting it with that of the points presented by a horse to the eye of the careful breeder, remarks that it—pedigree—"can never be accepted in the room of good and useful qualities, but simply as a guarantee for the certain transmission of the many good qualities which the well-bred cart-horse must in addition possess."

The illustrated paper on "The Mare and Foal," by Professor J. Wortley Axe, in the Journal of the Royal Agricultural Society of England (3rd series, vol. ix., 1898), will well repay perusal. It has been reprinted as a shilling pamphlet of 60 pages, and is published by Mr. John Murray, Albemarle Street, London.

## CHAPTER V.

## ON THE REARING AND TRAINING OF COLTS.

**D**URING the first summer the foals may be allowed to run with their dams until Michaelmas, or even longer if the weather continues mild and open. They should then be weaned and kept in fold-yards, or paddocks containing open sheds, with low racks and mangers for receiving their food, which ought, at first, to be the sweetest hay that can be procured. Where rowen or aftermath is available, it will furnish a succulent and invigorating article of diet: hay and rowen, bran, oats, or pollard, or a moderate quantity of bean-meal—the proportions varying with circumstances—will constitute the staple food. By feeding young colts with oats, in conjunction with other food, they acquire more rapid growth, and greater strength, than when they are fed only with bran and hay; and will also be enabled to endure greater severity of weather. The corn, of every kind, should be previously bruised in a mill. It may be assumed as an axiom, that there is no greater error in the breeding of animals, than the too common one of stinting them during the early part of their growth. It is at this period that they require the greatest nourishment, and if it is withheld they will be injured in their constitution, and consequently in their value, to a far greater extent than can be repaid by any possible saving in their food. To no animal does this remark apply more forcibly than to the horse.

It is a common practice, on *weaning foals*, to put them into warm stables during the following winter, from a notion that they are not, at that early age, able to support the cold of an open shed. Whether this may be judicious with regard to the more tender breeds of racing horses, it is not our present object to inquire; but with respect to the progeny of the dray-horse, the cart-horse, or the roadster, it is unquestionably wrong. These, from the nature of their future employment, must necessarily be exposed to vicissitudes of weather; and they cannot be too early inured to a certain degree of hardship. They should, indeed, be prevented from lying out in the wet at night; but, during the day, they cannot be too much abroad; and dry sheds are far to be preferred to warm stables for their nightly shelter. It has even been found that young colts, who had shown symptoms of disease while kept with all the care usually bestowed on hunters, have recovered when removed to a paddock; and that weaned foals have thriven better when only sheltered in a rick-yard than when housed.<sup>1</sup>

Colts, thus treated, will have acquired sufficient strength and hardihood, before the second winter, to be enabled to brave the inclemency of

<sup>1</sup> See Parkinson on Live Stock, vol. ii., pp. 65—67.

the season, without any other food than hay, or any other covering than that with which nature has provided them.

Mr. Gilbert Murray, who reared from sixty to eighty foals every year, communicated the following practical remarks to the "Farming World Year-Book":—

The foal should be taught to eat crushed oats and other artificial foods while still sucking the dam.

Foals should also be accustomed to be handled, and occasionally led, from birth. A light leather headstall should be put on at a week old, and allowed to remain. The young animal should have a leading lesson at least once a week.

At weaning time the foal is separated from the mare and confined in an isolated yard or loose box with manger, and a liberal supply of pure water. Unless there are several foals the young animal must be placed along with a companion. A quiet old pony or even a donkey will suit. Being already accustomed to artificial food, the foal will feel the want of the milk lightly, and it soon settles down to its altered circumstances.

In a week it may be turned into a pasture-field during the day. At the same time, an allowance of artificial food should be continued. The auxiliary food should be carefully selected, and rich in flesh-formers. The object here is to encourage muscular development. Heat and fat-producers are required only to a limited extent.

Experienced breeders never turn out their weaning foals on a bare pasture, for the obvious reason that there is the danger of picking up the eggs of certain parasites, which may effect a lodgment in the system, to the subsequent injury of the young animal. Where breeding is systematically carried on to any considerable extent, a pasture-field is purposely set aside for the weaning foals. Meadow foxtail, cocksfoot, and rye-grass are the favourite grasses. These are allowed to run to seed, so that the foals, when turned in, only crop the seed stems.

As the season advances, a shelter of some kind must be provided. A sheltered shed with a roomy open yard answers best; the shed is eighteen feet wide, having a passage of four feet in the front of the manger where the attendant goes in and places the food in the manger, without in the least disturbing the animals. The boxes are divided by swing rails. This puts a stop to kicking, and the foals can see their companions in the next box. They generally stand in pairs. A water-trough is placed in the manger, so arranged as to furnish a constant supply. The young animals are let out to the pasture each day after their morning meal, and return again in the evening. The hay is cut into chaff, mixed with the proper quantity of meal, and steamed, but not fed in a warm state, at least never over 60° F. Moss litter is used for bedding, hence no drainage is necessary.

Concerning light horses, Mr. Armstrong says, "most blood-stock breeders try to get their foals to fall as early in the year as possible, so that their early competitors shall be younger, or at any rate not a month older than themselves. Hunter breeders have no such object, and the best time for an ordinary hunter foal to fall is about April, soon after which time a bite of new grass will stimulate the mare's milk, and also

supplementally feed the foal at about the age when he is disposed to nibble it; and when, also, his very short neck has grown long enough to reach the ground.

Value of Mare, £80.			
	£ s. d.	£ s. d.	£ s. d.
For service to mare . . . . .	3 3 0		
Add 33 per cent., proportion of unfruitful services . . . . .	1 1 0		
For loss of mare's work, and extra corn allowance whilst suckling . . . . .	2 2 0		
100 lb. beans and a little hay for foal . . . . .	0 10 0		
Add 5 per cent. for loss of foals . . . . .	0 12 0		
Add 2 per cent. for loss of mares . . . . .	1 12 0		
	<hr/>		
Cost of rearing foal to weaning time . . . . .			9 0 0
300 lb. beans . . . . .	1 4 0		
100 lb. oats . . . . .	0 7 0		
200 lb. bran . . . . .	0 10 0		
7½ cwt. best hay . . . . .	1 10 0		
7½ cwt. roots . . . . .	0 7 6		
	<hr/>		
Cost of winter keep for weaning colt <sup>1</sup> . . . . .		3 18 6	
Add 2 per cent. for loss . . . . .		0 10 0	
		<hr/>	4 8 6
Cost of rearing to one year old . . . . .			13 8 6
20 weeks' grass . . . . .	3 0 0		
100 lb. beans and oats . . . . .	0 7 6		
	<hr/>		
Cost of summer keep for yearling . . . . .		3 7 6	
1100 lb. beans, oats, and maize . . . . .	4 0 0		
225 lb. bran . . . . .	0 11 0		
12 cwt. hay . . . . .	1 16 0		
16 cwt. roots . . . . .	0 16 0		
	<hr/>		
Cost of winter keep for yearling <sup>1</sup> . . . . .		7 3 0	
Add 2 per cent. for loss . . . . .		0 14 0	
		<hr/>	11 4 6
Cost of rearing to two years old . . . . .			24 13 0
20 weeks' grass for summer keep . . . . .		4 10 0	
2200 lb. oats and maize . . . . .	7 14 0		
225 lb. bran . . . . .	0 11 0		
1 ton hay . . . . .	3 0 0		
	<hr/>		
Cost of winter keep for two years old <sup>1</sup> . . . . .		11 5 0	
Add 2 per cent. for loss . . . . .		1 0 0	
		<hr/>	16 15 0
Deduct value of work equal to one-half cost of winter keep . . . . .		5 12 6	
		<hr/>	11 2 6
Cost of rearing to three years old . . . . .			<u>£35 15 6</u>

"As a rule, a foal gets on very well till the autumnal grazing fails both himself and his dam. Then is the time to hold out the sympathetic handful of corn and bran and other nice digestible foods, maintaining or increasing the supply throughout the first winter. The cost is very little, say a shilling a day, and on the first of May you will turn out to grass such a robust yearling as will take care of himself and do well

<sup>1</sup> The value of grass consumed when at exercise on winter pastures, and of straw eaten in the yards is not estimated.

during the next three winters at small cost, and be a far better four-year-old than the foal that is debilitated by starvation during his first and coldest and most cruel winter."

The interesting financial statement set forth on page 433, was drawn up by Mr. Reynolds to represent the profit which may be expected to accrue as the result of breeding from animals of a high class, and the

ESTIMATE OF COST OF REARING A WINTER FOAL TILL IT IS 2½ YEARS OLD.

	£ s. d.	£ s. d.
Covering fee . . . . .		2 2 6
Foaled November 15, dam's keep for 3 months, 6 stone equal proportions of maize, oats, and beans . . . . .	0 6 0	
1 cwt. stover . . . . .	0 4 0	
3 bushels roots . . . . .	0 1 0	
	<hr/>	
Per week . . . . .	0 11 0	7 3 0
3 months' keep to May 15 as before; but the mare going to work to help the spring sowing, only one-third of her keep should be charged to the foal . . . . .	2 7 6	
The foal, ¼ peck of oats per day, in addition . . . . .	0 17 4	
	<hr/>	3 4 10
Weaned May 15; 4½ months' keep to September 30 at grass, and 1 peck of oats per week @ 3s. . . . .		3 0 0
7 months' feed to April 30, @ 5s. 6d. per week, consisting of 3½ pecks of oats, ½ cwt. of clover hay, 2 bushels of roots, with a run at grass . . . . .		8 5 0
5 months' feed to September 30, @ grass only, 3s. 6d. per week . . . . .		3 16 6
7 months' feed to April 30, 7s. per week, comprising 3 stone maize meal, ½ cwt. clover hay, 2 bushels of roots, with a run out at grass in open weather, or straw . . . . .		10 10 0
	<hr/>	
The cost at 2½ years old . . . . .		£38 1 10

And should be fit for work or sale.

ESTIMATE OF COST OF REARING A SPRING FOAL TO TWO YEARS OLD.

	£ s. d.
Covering fee . . . . .	2 2 6
7 months' feed of mare and foal from March 1 (say) to September 30, @ 6s. 6d. per week . . . . .	9 15 0
7 months' keep till April 30, @ 5s. per week. 3 pecks of oats, ½ cwt. of stover, 2 bushels of roots, and a run out at grass . . . . .	7 10 0
5 months' feed to September 30, @ 3s. 6d. per week, grass only . . . . .	3 13 6
7 months' feed to April 30, 7s., 3 stone of maize meal, ½ cwt. of stover, 2 bushels of roots, a run at grass in open weather, or barley straw . . . . .	10 10 0
	<hr/>
	£38 11 0

Now Two Years old. The colt thus kept should be fit for work at once.

rearing of their offspring in such a manner that they will be maintained throughout the whole period of their growth in the best possible condition as growing animals. A similar statement representing the consequences of breeding from an inferior mare valued at £45, and rearing the colt by systems of management commonly practised, shows the cost of rearing to three years old to be £26 13s. and the profit on the colt—sold at £50—to be £20.

It is assumed that the value of a colt's work from three years old to the time he is sold for commercial purposes will be equal to the cost of



his maintenance, and that if he realises £80 as a town horse, the total nett profit to his breeder and rearer will be about £45.

The estimates of the cost of rearing winter and spring foals respectively, as set forth on page 434, are those of the late Mr. G. M. Sexton. The difference in cost, £4 10s. 10d., between the winter and spring foal is regarded as more than compensated by the convenience of not having all the mares foaling at the same period, and especially by having the winter mares for the spring work. Possibly, indeed, there is a margin in favour of the winter foal, seeing he is the older by six months, and will be ready for work earlier in the spring.

The *process of training* horses for the saddle often requires considerable skill in the breaker. For those intended for the plough, it is very simple; but, for both, the best means are gentleness and patience. The horse is an animal possessed of great intelligence. He is capable of considerable attachment and of equally strong resentment. If treated with kindness he becomes docile; but severity generally fails of its object, and renders him intractable. There is certainly much difference in the natural temper of colts, some requiring more care and time to reduce them to obedience than others; but even the most restive may be rendered manageable by kind and gentle usage.

From the moment of its being weaned, the foal should be accustomed to the halter, and wisped over and occasionally tied up, but this should be done by the person who feeds it, and never entrusted to lads, who will probably worry the animal and teach it dangerous tricks; nor to any hasty, ill-tempered man, who would be likely to ill-treat it. The colt will thus early become accustomed to be handled, and will consequently occasion much less trouble than if it had been previously neglected.

After the colt has been a day or two in the stable, a bridle should be put on; but with a small bit at first, instead of the large one usually employed by horse-breakers, which, by the horse's champing on it with impatience, sometimes occasions the mouth to become callous. He should then be led about, and accustomed to obey the rein in turning and stopping, which he will very soon learn to do.

After a few days, he should be completely harnessed, and put into a team with some steady horses. At first he should be neither whipped nor forced to draw, but left quietly to walk with the other horses. In a very short time he will imitate them, and begin to pull. It may then be proper to let some one mount him, even if he should not be intended to be commonly ridden, as it will render him the more docile. This will be the best done while he is in the team, as the other horses will prevent him from plunging. No violence should be used; for such is his intelligence, that while he will readily learn everything that he is taught, he will also recollect many things that it might be wished he should forget. Thus, if he is beaten for starting at any particular object, he will only start the more on meeting it again, for he will remember the chastisement it occasioned; and if hurt in shoeing, or on any other occasion, he will not soon forget the pain it produced, or suffer a repetition of it without impatience.

The subjoined remarks communicated by Mr. C. W. Wilson to the "Live Stock Journal Almanac," are well worth repeating. After

referring to the mistaken idea current amongst many as to the existence of hereditary vice in animals, Mr. Wilson proceeds:—"I quite admit that most diseases are transmissible from parents to offspring. I also hold that temper is transmissible, and that either a quick or a slow temper can be intensified or modified according to the mating of sire or dam, for when a high-spirited or quick-tempered mare is mated with an equally quick-tempered horse, the characteristic will be heightened in the progeny, and *vice versâ*; but I cannot place these characteristics of temperament under the category of hereditary vice. By many, too many, however, they are so classed, and when the high-spirited and playful young horse or pony comes under the charge of a groom holding this erroneous notion, he remembers that the sire or dam also showed evidence of the same mercurial temperament, and he has not a shadow of a doubt in his own mind as to the repressive treatment to be pursued. The vice (?) must be curbed in its incipient stage, and from that hour the animal never knows what kind usage means. Blows, cuffs, and harsh words are henceforth its portion, and when it is given into the hands of the breaker, its character is given with it, and the same mistaken treatment is continued, until what wonder if it emerges at last a demon in its temper! Again, if the young animal be descended from parents of lethargic temper, it is at once put down as sullen and wicked; its father or mother was so, it is remembered; that must be taken out of it, and by the same means—harshness and brutality. Thus, only those animals of placid and equable temperaments have the chance of escaping this mistaken system of training, and the quick and the slow are spoiled. There is probably no animal so sensitive to kindness as the horse; no animal, unless it be the dog, so attached to man; no animal that, under firm and kind treatment, would be more amenable to man's control. With the treatment above described, need we wonder that the animal becomes reckless, nervous, or sulky, and liable to be thrown off its balance in emergencies? It has never experienced kindness from man, consequently it has no confidence in him, and to this I attribute a great proportion of the accidents that occur. What can stop a pony pulling and make him settle down to his work quicker than a kind word, provided he is not frightened at his master's voice?"

The proper period for *castration* depends on the breed of the horse, and the purpose for which he is designed. On the colt destined for common agricultural purposes, it is usually performed when he is about twelve months old. It is an operation then attended with little danger, provided the weather is not too hot.

If the colt, however, is intended either for heavy or for speedy draught, the operation should be delayed until the animal is a year and a half or two years old, when his fore-quarters will be tolerably developed. It should then be performed as speedily as may be convenient, lest he should become too heavy before, and perhaps a little self-willed. May or September are the best months for the performance of the operation.

Castration, being the business of the veterinary surgeon, need not be described here.

## CHAPTER VI.

## OF THE AGE, QUALIFICATIONS, AND SALE OF HORSES.

THE names by which horses and mares are distinguished while young, are—in the case of horses, *colt foals* during the first year, and afterwards *yearlings*, then *two-year-old colts* and *three-year-old colts*, until four years old; when they become *geldings*, if castrated, and otherwise *entire horses* or *stallions*.

Mares are called *fillies*, while sucking; then *yearlings*, *two-* and *three-year-old fillies*, until four, when they finally acquire the appellation of *mares*.

The *age* is calculated from the first of January.<sup>1</sup> Previous to that time, a horse may be said to be *rising* four, five, or six years old, as the case may be; but when that is passed, he is four, five, or six years old, until after seven years, when he is termed *aged*.

The following hints, relative to the age and the essential characteristics of the horse, may not inappropriately form a part of the present chapter:—In old horses, the eye-pits are generally deep; although this mark is considered uncertain, as it also occurs in young horses that are descended from aged stallions. There are also a few grey hairs about the face, the lips are thin, and not perfectly closed—the withers are high—the back is sinking, and the quarters lengthening. There is, however, a great deal of uncertainty about these details, and the only criterion to be depended upon is that derived from the teeth, the number of which amounts to forty; namely, twenty-four grinders, or double teeth, and sixteen others—four tushes or tusks, and twelve cutting or front teeth; these last are the surest guides for discovering the age of a horse. As mares usually have no tusks, their teeth are only thirty-six. A colt is generally dropped with two grinders on each side, and in seven or eight days the two

<sup>1</sup> It is customary to calculate the ages of all thoroughbreds from January 1, and of other horses from May 1. The terms “off” and “coming” are employed with the understanding that they mean the addition to or subtraction from the stated age of a few months. Thus “three years off” means three years and about three months; and “coming four years,” means that the horse wants about three months to complete the year. It is not essential that the examiner should conform to usage in respect of the terms above mentioned, unless he thinks fit to accept them; nor is he compelled to insist that the year shall be completed in all cases on the first of January or May. The statement of the opinion of a horse’s age will be made absolutely, and without any reference to an arbitrary standard, which nevertheless may, for ordinary purposes, have a certain amount of convenience.

In reference to horses which are exhibited in different classes at shows, a question has more than once arisen as to the precise meaning or intention of the terms applying to the class, and the question has not yet been answered in a satisfactory manner. For example, an animal entered in the four-year-old class has a condition of dentition which indicates that he is nearly five years old. This may be admitted by the exhibitor, but he also contends that the horse is a four-year-old until he has reached his fifth birthday. If this plea be allowed, it is obvious that a horse foaled in the beginning of the year may have to compete with one which was foaled late in the same year.—Professor Sir George Brown, C.B., in the *Journal of the Royal Agricultural Society*.

central teeth or pincers, above and below appear. In about six weeks the two next (the middles or laterals) are seen, and, in six or seven or eight months, the two corner ones. He has now six front or incisor teeth in each jaw, and he retains them until he is two years and a half old, which makes it difficult, without considerable care, to avoid being imposed on during that interval, if the seller find it to his interest to make the colt pass for either younger or older than he really is. An inspection of the teeth, however, will prevent serious imposition.

The teeth are covered by a hard and polished substance, called the

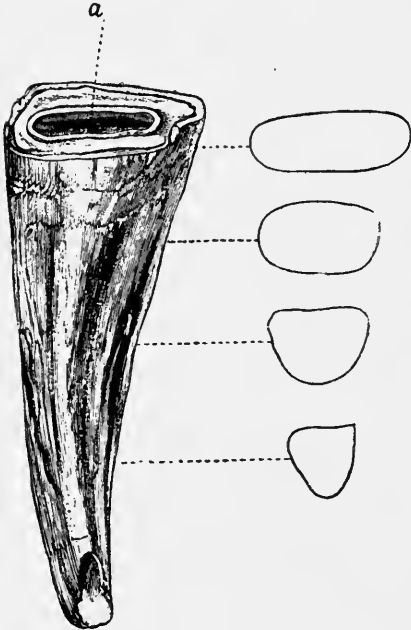


Fig. 95.—Permanent Incisor of the Horse.

Showing the "mark" (a), and, on the right, the varying outline of the biting surface induced by wear.



Fig. 96.—Incisor Teeth of the Horse.

A. Temporary.  
B. Permanent.

enamel. It not only spreads over the upper part of the teeth, but in the horse it sinks into a furrow or groove on the cutting surface. Portions of food becoming lodged in this groove, and there hardened and blackened, constitute what is called the *mark* of the incisor tooth (fig. 95). This furrow is wide at the top, and contracted towards the bottom. As the edges of the front teeth are worn away in plucking the food, a portion of the blackness is rubbed off, and the mark becomes fainter, and at length quite disappears. The gradual progress of this will enable a person who is at all accustomed to horses to guess, with considerable accuracy, at the age of the animal. With some variation, depending on the nature of the food, the mark in the

two central front teeth will become worn out, and at two years in the case of the temporary dentition it will be gone, and considerably diminished in the tooth on either side.

The frauds of the breeder or the dealer may have, ere now, possibly commenced. He has a likely two-year old colt that was dropped early in the year, and whose good qualities are considerably developed. If he could make him pass for a three-year old, he would be worth 10% more. His central front teeth are extracted, the central permanent teeth rapidly grow, and the mouth of the colt is apparently that of a three-year old one.

At from two years to two years and a half old, sometimes sooner,



Fig. 97.—Incisors of Horse at Three Years Old.

The two centrals are new permanent teeth ; the two laterals and the two corners are worn deciduous teeth.

and sometimes later, according as he has been fed, a horse begins to change his teeth. The pincers, which came the first, are also the first that fall ; so that, at three years, he has four horse's and eight colt's incisors, which are easily known apart, the former being larger, flatter, and yellower than the others (fig. 96). The appearance of the teeth at three years old is shown in fig. 97.

When the horse is coming four years old he loses the teeth (the laterals) on either side of the central ones, and four others supply their places, which follow the same rule as the central ones. He has now eight horse's incisors and four colt's.

The dishonest breeder or dealer is more anxious than before to give the appearance of an additional year to the colt, and the same trickery is displayed, with regard to these teeth, as with the central ones in a preceding year.

During this year also, the four tushes, which are seldom seen in the



Fig. 98.—Incisors and Tushes of Horse at Five Years Old.

All the teeth shown belong to the second or permanent dentition, the corners being comparatively new, and slightly worn on the anterior edge only.

mare, although the germs of them are present, begin to protrude; the lower ones often four months before the upper ones. The two lower tushes (fig. 98) offer the most certain proofs that a horse is coming five years old, notwithstanding his colt's teeth may not be all gone.

It is not an infrequent practice, in order to make colts appear to be five years old when they are but four, to pull out the last temporary incisors; but if all the colt's incisor teeth are gone, and no

tushes appear, the purchaser may be certain that the trick has been played.

When a horse is coming six years old, the mark is disappearing from the two lower central front, or incisor teeth, or there remains only an inconsiderable black spot. Between six and seven the mark disappears from the two middle teeth; and between seven and eight the corner teeth follow the same course. After this it is difficult to determine with certainty the age of a horse, and he is technically said no longer to have the mark in his mouth. In this case recourse must be had to the tushes. At four and a half years old they are rounded and prominent in front, grooved on either side, and concave on the inside surface, with sharp edges. At five years old the tush has increased—the grooves are disappearing—the outer surface is more regularly convex, and the inner surface remains concave. At six years old the tush has attained its full growth, and still remains convex without and concave within. At seven the tush is rounded at the point and edges—still prominent without, and beginning to be a little so within. At eight the tush is still blunter and rounder every way. The degree of bluntness and roundness of the tush will continue to increase every year, and some rude guess may be formed of the age of the horse, although nothing certain can be determined. Horses that are kept in the stable always have the mark in the incisor teeth worn out sooner than those at grass, while it is difficult to guess at the age of a crib-biter. Generally speaking, the mark is worn away from the central incisor teeth of the upper jaw at nine years old, from the next pair at ten, and from all of them at eleven. The lower front teeth after this project forward, and at length assume almost a horizontal position, and the upper ones project over the lower ones, wearing down the outer edge, and making that, contrary to what takes place in youth, the lower of the two.

The subjoined table may be of some service as a guide to the determination of the age of a horse by an inspection of the teeth :—

Teeth.	First Appearance.	Replacement.
<i>Incisors.</i>		
Centrals or Pincers . . .	Before or soon after birth	2 to 3 years
Laterals . . . . .	4 to 6 weeks	3 to 4 years
Corners . . . . .	6 to 9 months	4 to 5 years
<i>Canines.</i>		
Tushes (in horse) . . .	6 months	4 to 5 years
<i>Pre-molars.</i>		
I. First pair . . . . .	Before or soon after birth	2 to 3 years
II. Second pair . . . . .	„	„
III. Third pair . . . . .	„	3 to 4 years
<i>Molars.</i>		
IV. First pair . . . . .	10 to 12 months	
V. Second pair . . . . .	2 to 2½ years	
VI. Third pair . . . . .	4 to 5 years	

The trick called *bishoping*, made use of by dealers to prolong the appearance of the mark in the teeth, and make an eight- or nine-year-old horse appear only six or seven, is thus performed:—They cast the horse in order to have him more at command, and with a steel graver, like that used for ivory, hollow the middle teeth a little, and the corner ones somewhat more; they then fill the holes with resin, pitch, sulphur, or some grains of wheat, to which they set fire with a piece of hot wire, of the size of the hole. This operation they repeat from time to time, until they give the hole a lasting black appearance, in imitation of nature. Notwithstanding this fraudulent attempt, the hot iron forms a little yellowish circle round the holes, similar to that which it would leave upon ivory. Hence, there is another trick to prevent detection while the horse is under examination, and that is, to cause a quantity of foam to gather about the mouth, by rubbing a little salt, or dried bread crumbs with salt, on the lips. This foam partially hides the circle made by the iron.

It is at least open to question whether the tricks that are played with horses' mouths are either so frequent, or so successful, as to constitute an important element in the question of the value of the evidence of age which is afforded by the teeth. Certainly, it is to be hoped that the following description of what once was is no longer applicable:—

In Yorkshire and the midland counties the young stock are generally kept until rising three or four years old; but many are sold at an earlier age, particularly from the Lincolnshire fens. The method practised by the Yorkshire farmers, in making up their two-year old colts for sale, is to take them up from grass in the autumn, only a week or two before the time at which they are to be sold, in order to reduce their carcass, improve their coat, and teach them to lead. They are then disposed of, with their full tails, to the dealers, who afterwards shamefully make them up more according to art. In the hands of their new masters their teeth undergo the operations already described; they are also docked and nicked, and, after being kept on mashes made of bran, ground oats, or boiled corn, they are bought by the London dealers, who sell them as if they were five years old. They are then taken to immediate work, and in a few months many of them are completely destroyed by premature and severe labour—for nothing ruins a colt more speedily and effectually than being prematurely put to heavy or severe work. This drawing of the teeth, however, is not a fraud practised on the London dealers, who are, on the contrary, not only aware of the deception, but require it to be done.<sup>1</sup>

<sup>1</sup> Agricultural Survey of Yorkshire, North Riding, p. 277.



## CHAPTER VII.

### THE MAINTENANCE AND LABOUR OF FARM-HORSES.

THE support of horse-teams forms so material a portion of farming expenditure, that, although not immediately connected with grazing, a few observations on the subject will not prove uninteresting or useless.

No precise formulæ can be laid down, as so much will necessarily depend upon the kinds of food the farmer has at his disposal, and the amount of work he requires from his horses.

To feed economically and yet efficiently is the great desideratum. It is a well-known fact, that two well-fed horses will do the work of three if not four that are badly kept; hence it will be evident that to maintain a small number of horses, and to keep them well, is more advantageous than to have a larger number, and so under feed them that they are never capable of doing a hard day's work. There are, no doubt, many persons who keep their teams expensively, for the mere vanity of having them in good condition; while there are others who obtain continuous service from their farm-horses under a very different regimen.

Mr. Read, in his essay on the "Management of Farm Horses," gives the following formulæ as guides for winter feeding. Whilst the quantities remain the same, allowance must be made for fluctuations in prices. No. 1 is for a moderate-sized farm-horse, and No. 2 for a larger animal, per week:—

No. 1.		No. 2.	
	<i>s. d.</i>		<i>s. d.</i>
7 pecks of oats (70 lb.) . . .	3 6	7 pecks of oats (70 lb.) . . .	3 6
8 pecks of chaff . . . . .	1 0	1 peck of beans, crushed . . .	1 6
2 pecks of bran . . . . .	0 6	8 pecks of chaff . . . . .	1 0
120 lb. of hay . . . . .	3 0	2 pecks of bran . . . . .	0 6
7 lb. of beans . . . . .	0 6	140 lb. of hay . . . . .	3 6
	8 6		10 1 <sup>1</sup>

In order to reduce still further the expense of horse-keeping, various trials have been made of the nutritive powers of potatoes, Swedish turnips, carrots, and other esculent roots, all of which have been found sufficient for the support of the animals during moderate work, and when given with plenty of hay. They have even been found to answer the purpose when given with straw only; but in that case the work must have been very light, for horses should have food of a quality proportioned to their work, and, if that is considerable, some corn is absolutely necessary. In fact potatoes and roots, especially when given with corn bruised, or barley-meal, are better adapted for bringing horses intended for sale into condition than for maintaining them in working order. The quantity of nitrogenous food commonly given may, indeed, be diminished with the aid of roots, and straw may be

<sup>1</sup> Veterinarian, 1849, p. 338.

substituted for hay; but, in every instance, the quality of the food must be in proportion to the required exertions, or the horse will be injured to a degree which the saving effected in his keep will not recompense. Theorists adduce instances to the contrary, but every practical farmer knows that hard work can only be sustained by good feeding. This, however, may be carried to excess; and, although farmers cannot be generally accused of being too lavish of corn, yet the allowance of hay is often far too profuse. It is, indeed, a common practice to cram the rack with an unlimited quantity of this fodder; the consequence of which is that gross feeders stand eating half the night instead of lying down to rest. Their stomachs become unnaturally distended, and many serious disorders are generated that might have been avoided by a more regular and a more limited allowance. Nor is this the only loss this system causes the farmer; quantities of the fodder are pulled down, dropped, trampled under foot, and utterly wasted. The great secret of feeding well is to feed regularly at certain hours, and in fixed but sufficient quantities, and not to allow any intermediate eating. A full meal should not be given immediately after a horse has come in from a hard day's work; let him have a little food to take off the edge of his appetite, and the remainder an hour or two afterwards when he is rested.

Of the succulent foods, sliced potatoes and carrots are those most commonly given; and it is a singular fact that, although the former contain the greater proportion of nutritive matter, horses thrive better on the latter. When potatoes are steamed, and thus deprived of the water of which they are in a great measure composed, and which has been supposed to have a pernicious effect, they form a tolerably substantial food; but the trouble and expense of the process are great objections to giving the tubers in that way, and, when raw, carrots are preferable. Horses are fonder of them; they have a visibly good effect upon the coat; they are found advantageous to the wind; and they correct the binding effect of dry food. But too many given raw are apt to produce evils of other kinds, and horses which have been fed on them for a short time often become so fond of them as to refuse other food.

In some parts of the North, the refuse oats, or any other refuse grain, or pulse, are mixed with wheat-chaff or cut hay,<sup>1</sup> and boiled;

<sup>1</sup> As showing the inadequacy of oats and hay alone to maintain the condition of horses undergoing severe labour, Mr. Charles Hunting presented to the Newcastle Farmers' Club the following illustrative case. He was called to a Durham colliery where the output had undergone a decrease of some fifteen or twenty score per day on account of the horses being unable, from want of condition, to get the work out. The animals were miserably poor, notwithstanding their allowance of 168 lb. of oats and 154 lb. of hay per head per week. The oats were not crushed, and the hay was not chopped. The horses were large, none under 16 hands, many 16·2. They worked very long hours, and took heavy loads. On September 1st their food was changed to the following:—

				s.	d.
Crushed peas	35 lb.	@ 34s.	per quarter	.	2 4
„ harley	20 lb.	@ 28s.	„	.	1 3
„ oats	40 lb.	@ 28s.	„	.	3 4
Bran	14 lb.	@ 7½d.	per stone	.	0 7½
Hay	7 st.	@ 9d.	„	.	5 3
Total				.	12 9½

and of this mess, after it has become cool, almost a pailful and a hal are given to each horse once a day, generally when his work is over. This is a judicious and economical practice, as very light corn is often swallowed whole when given dry. When horses are kept partly upon straw, it is an excellent mode of preserving their bowels in good order; but when put to hard work, and fed on hay, its constant repetition would perhaps be too relaxing.

Mr. Spooner, in his Prize Essay on the "Management of Farm Horses," gives, from his personal knowledge, the following estimates of the cost per week of feeding farm-horses. These are retained as indicating quantities, but the cost will necessarily vary with market fluctuations in the value of produce. From the middle of November to March, when the work is light, they receive :—

		s.	d.			s.	d.	
Oats, 1½ bushel	.	.	4	6	Oats, 2 bushels	.	6	0
Straw, 1½ cwt. at 2s.	.	.	3	6	Beans, 1½ peck.	.	2	3
Swedes, 42 lb.	.	.	0	4	Hay (not clover), 1 cwt.	.	4	0
				8			12	3

The second allowance is given as the spring work comes gradually on. When barley and turnip sowing are nearly over, and green food becomes abundant,

	s.	d.
The corn is reduced to 1 bushel	3	0
Green food is given <i>ad libitum</i> , and costs, say.	5	0
Making per week	8	0

As the wheat sowing approaches, the spring feeding is again given. Thus we have for

	£	s.	d.
3 months a weekly expense of	0	8	4
3 " " "	0	12	3
3 " " "	0	8	0
3 " " "	0	12	3
	2	0	10

making the total cost average 10s. 2½d. per week, or 26l. 10s. 10d. per annum.

The old system of feeding gave—

	s.	d.
Oats 163 lb. @ 2s. per quarter	14	0
Hay 11 st. @ 9d. per stone	8	3
Total	22	3

Difference 9s. 5½d. per horse per week.

Besides the saving in money, the digestive organs had 56 lb. less hay and 59 lb. less corn to digest. Or :—

Mixed grain	109	lb.	Old Oats	168	lb.
Hay	98	lb.	Hay	154	lb.
Total	207	lb.	Total	322	lb.

The result was that within three months the stud was in excellent condition, drawing out of the pit, without any application of engine power, about twenty to thirty scores more per day than when they were first put under the fresh diet. As there were 149 horses on the colliery, a saving computed at £3,622 per annum was thus effected.

On another farm the following is the feeding system adopted:—

		<i>s. d.</i>			<i>s. d.</i>
13 weeks on oats, 1½ bushel . . .		4 6	13 weeks on pollard, 2½ bushels . . .		3 1½
„ beans, 2 pecks . . .		3 0	„ beans, crushed, 2 pecks . . .		3 0
„ hay, 1½ cwt. . . . .		6 0	„ hay, 1½ cwt. . . . .		6 0
		13 6			12 1½
13 weeks on pollard, 2½ bushels . . .		3 1½	13 weeks on bran, 2 bushels . . .		2 0
„ beans, crushed, 2 pecks . . .		3 0	„ beans, 1 peck . . .		1 6
„ straw . . . . .		1 9	„ cut clover, tares, and		
„ swedes, 70 lb. . . . .		0 8	pasture . . . . .		4 6
		8 6½			8 0

The following is the third system of feeding; and this is considered as preferable to the one above given, but inferior to the first, which, though the most expensive, is that best calculated to keep horses in good working condition:—

		<i>s. d.</i>			<i>s. d.</i>
13 weeks on 1½ bushel of oats . . .		4 6	13 weeks on 1 bushel of oats . . .		3 0
„ 1 peck of beans . . .		1 6	„ clover, vetches, &c. . . . .		5 0
„ 1 cwt. of hay . . . . .		4 0			8 0
		10 0			
13 weeks on 2 bushels of oats . . .		6 0	13 weeks on 1 bushel of oats . . .		3 0
„ 1 peck of beans . . .		1 6	„ clover . . . . .		4 0
„ 1 cwt. of hay . . . . .		4 0			7 0 <sup>1</sup>
		11 6			

On page 448 is given Mr. G. M. Sexton's estimate of the annual cost of horse keep, *i.e.*, cost of food, exclusive of management expenses. The amount will, of course, vary according to price of feeding stuffs, but horses kept as indicated are in good working condition. Variations in season must determine the periods of changing the food; for instance, green food may be commenced three weeks earlier some seasons than others, and may be discontinued as many weeks earlier or later towards the autumn. The cost of keep per horse will be from 2s. to 2s. 6d. per week more if provender has to be provided, cut, and carried to the stables or yards.

Mr. W. R. Trotter, in an essay contributed to the first volume of the English Cart Horse Stud Book (Shire Horse Stud Book), has the following note on feeding:—In many districts the feeding of the whole stud of farm horses is entrusted to one man. In the North of England it is not the custom to have a horse-keeper, and nothing is so much disliked by the ploughmen as to appoint another man to feed their horses; this is, no doubt, simply a custom, as it is much better when the feeding is entrusted to one man. Regularity of feeding cannot be too strongly urged, as the animals know the feeding times exactly, and if they are not fed at the proper time they become restless, and do

<sup>1</sup> Journal of the Royal Agricultural Society, vol. ix. p. 275.

not get the benefit of respite from work they otherwise would. The best plan for large establishments is to have a board put up in the stable, with the times of feeding, grooming, &c., distinctly specified thereon. Much harm is often done by ploughmen drugging their horses in order to improve their appearance; this should be strictly condemned and forbidden. A farmer may unfortunately get into a breed of horses that are easily put off their feed, and the use of a condiment may be necessary. However, it should be remembered that manufacturers of condiment make immense profits, whilst the following recipe may be made up at home for about £12 per ton, equally as good as those condiments usually sold at £30. The prices quoted below are subject to considerable fluctuations :—

RECIPE FOR MAKING A TON OF CONDIMENTAL FOOD.

		cwt.	qr.	lb.
Locust beans, finely ground, @ £6 per ton	. . .	6	0	0
Indian corn @ £7	. . .	9	0	0
Linseed cake " @ £7 10s. "	. . .	2	3	18
Powdered turmeric, " @ 8d. per lb.	. . .	0	0	40
Sulphur " @ 2d. "	. . .	0	0	40
Saltpetre " @ 5d. "	. . .	0	0	40
Liquorice " @ 1s. "	. . .	0	0	27
Ginger " @ 6d. "	. . .	0	0	3
Aniseed " @ 9d. "	. . .	0	0	4
Coriander " @ 9d. "	. . .	0	0	10
Gentian " @ 8d. "	. . .	0	0	10
Cream of tartar " @ 1s. 8d. "	. . .	0	0	2
Carbonate of soda . . @ 4d. "	. . .	0	0	6
Levigated antimony . . @ 6d. "	. . .	0	0	6
Common salt . . . @ 0½d. "	. . .	0	0	20
Peruvian bark . . . @ 4s. "	. . .	0	0	4
Fenugreek . . . @ 8d. "	. . .	0	0	22
		20	0	0

The late Dr. George Fleming, Principal Veterinary Surgeon to the Army, in the course of an article on the feeding of horses which appeared in the "Live Stock Journal Almanac," stated that, so long as a horse has plenty of time to eat it, a hay diet causes no inconvenience on account of its bulk, but when leisure is not allowed, or when he has to exert himself after a sufficient meal of hay, then injury is likely to be done. It has been remarked that, in the process of mastication, dry hay becomes mixed with four times its weight of saliva, while oats only require an amount of saliva equivalent to their own weight. It is said that a horse, in eating ten pounds of hay, loads his stomach with forty pounds of saliva in addition, or fifty pounds in all; but in consuming an equivalent amount of oats, say five pounds, he needs but five pounds of saliva, or ten pounds altogether. Therefore, in introducing into the system a given amount of flesh-forming aliment in the form of oats, the stomach is filled to only one-fifth the extent that would be necessary if the same quantity of nutrient material were given in the form of hay. But the ten pounds of hay, with its saliva, could not all be accommodated in the stomach at once, but only at three times, unless the organ is to be distended to more than the normal plenitude of two-

thirds of its full capacity. The five pounds of oats, on the other hand, with their five pounds of saliva, do not fill the stomach to one-third of its capacity, but leave the amplest opportunity for freedom of movement and the secretion of the gastric juice. It might be added that the ready digestibility and assimilation of the food is a very important matter, especially for hard-working horses, with which time is all-important. If the food is difficult of mastication, and requires a lengthy period to reduce it to the necessary condition of crushing and insalivation before being swallowed, then the animal gets less rest, and so much power is wasted by the muscular movement of the jaws; while, if it is indigestible, it takes a longer time to reach the blood, and fatigues the stomach before it is in a fit state to enter that vital fluid, besides loading the bowels with matters which are often worse than useless.

## COST OF HORSE KEEP.

	s. d.	£ s. d.
3rd week in Sept., Oct., Nov. (9 weeks),		
4 stone of maize meal . . . . .	3 8	
1 ,, of bean meal } . . . . .	2 8	
1 ,, of linseed cake } . . . . .		
1 cwt. of clover hay . . . . .	4 6	
Straw . . . . .	0 6	
	11 4	5 2 0
Dec. and Jan. (about 9 weeks),		
5 stone of maize meal . . . . .	4 7	
1 cwt. of stover . . . . .	4 6	
2 bushels of roots . . . . .	0 8	
Straw . . . . .	0 6	
	10 3	4 12 3
Feb. and March (8 weeks),		
4 stone of maize meal . . . . .	3 8	
1 ,, of bean meal } . . . . .	2 8	
1 ,, of linseed cake } . . . . .		
1 cwt. of stover . . . . .	4 6	
2 bushels of roots . . . . .	0 8	
	11 6	4 12 0
April (5 weeks),		
4 stone of maize meal . . . . .	3 8	
Green food, cut into yard . . . . .	5 0	
	8 8	2 3 4
May, June, July (13 weeks),		
3 stone of maize meal . . . . .	2 9	
Grass . . . . .	4 0	
	6 9	4 7 9
Aug. and Sept. (8 weeks),		
4 stone of maize meal . . . . .	3 8	
$\frac{1}{2}$ cwt. of stover . . . . .	2 3	
Grass . . . . .	3 0	
	8 11	3 11 4
Total cost of a year's keep . . . . .		£24 8 8

Oats and hay should be sound and good. In judging of them for food, it is well to remember the characters by which good may be

differentiated from bad oats. In the first place, each grain consists of two parts, husk and kernel, the latter possessing considerable alimentary value, and the former scarcely any at all; so that oats which contain the largest proportion of kernel are those which are most serviceable to the horse. The relative proportions of kernel and husk vary considerably in different kinds of oats. In some samples, the husk forms as much as 35 or 40 per cent., while in good grain it may be as low as 20 per cent. It is of importance sometimes to estimate quickly the feeding value of oats, and this can readily be done by separating the kernel from the husk by hand in a number of seeds, and then weighing each. This gives a better and a more practical indication than is afforded by the external appearance of the grains, their colour, or their weight collectively. It may be noted, besides, that oats which have the smallest proportion of husk are those which are most readily and thoroughly digested; and, as already mentioned, crushed oats are more quickly and perfectly digested than when they are whole.

The weight of the oats is not altogether a trustworthy index to their nutritive value, though it is that which is generally adopted; the thickness of husk and its closeness to the kernel, as well as the dryness of the grain, will influence its density; so that there is often a rather wide diversity in different samples, with regard to their natural weight and nutritive value. The ordinary oats, which weigh only 38 lb. to the bushel, are not very economical for feeding, especially if they come from Sweden or Russia, where their quality—particularly that of the Swedish oats—is rather low. It is better to give a smaller quantity of heavier thin-skinned oats.

Of course, the oats should be sound; when musty they are likely to do great damage. And the same may be said of the hay.<sup>1</sup> This varies considerably in feeding value, not only according to the grasses which enter into its composition, but also according to the situation, the soil, the district, and even to the country in which it is grown; the manner in which it is preserved or made also influences its value as food.

Other grains besides oats are sometimes substituted for these, wholly or in part. Maize is one of them, and is somewhat largely in use for omnibus and tramway horses. When the maize is broken it is very digestible and economical, and may replace one-third, two-thirds, or even the entire ration on occasion; but good oats are preferable, as they sustain animals which are undergoing severe labour much better, and do not soften the liver like maize.

Beans are a valuable adjunct to the food of hard-working horses when given in the proportion of one-tenth or one-twelfth to the other grain, and the same may be said of peas.

To maintain a just balance between food and work, which the condition of the horse will pretty accurately demonstrate, the owner must be ready to increase, and as promptly diminish, the grain allowance as demands upon it are created or disappear. If the quality of the food is not sufficient to furnish material for the repair of waste tissue, the deficiency must be met by the consumption of an increased quantity.

<sup>1</sup> Dusty hay made from flooded grass is dangerous to horses.

But an excessive supply of comparatively innutritious food to compensate for defective quality is not only embarrassing to the stomach, but hampers the horse with bulky dead weight. Severely worked horses require much more reparative material than those which are not so taxed, and they should therefore be supplied with more concentrated food, easier of digestion, and rich in flesh-forming qualities.

For the largest sized draught horse, which performs steady but hard work for a number of hours every day, 18 lb. of hay with a small proportion of straw cut into chaff, and 18 lb. of oats, with a pound or two of beans or peas added, is reckoned a fair daily allowance. However nutritious the food may be, less than 29 lb. per day will not, it is asserted, suffice to keep heavy horses in working condition. In a well-managed stud of cart-horses, the following was the daily allowance:—Maize, 10 lb.; Egyptian beans or Canadian peas, 5 lb.; oats, 2 lb.; oatmeal and linseed, 1·3 lb.; bran, 2·1 lb.; hay, 10·6 lb.; roots and grass, 3 lb. Maize, beans, or peas, with bran and cut hay, formed the basis of the usual food allowance. The oats and linseed were used only for sick or delicate-feeding horses. The oatmeal was made into gruel, of which each horse was allowed a drink on arriving at his stable when the day's work was completed. The bulk of the hay was given chopped along with the grain, which was crushed, two or three pounds only being put in the rack at night. In another stud of similar-sized horses, the daily ration was 13½ lb. oats, 16 lb. hay, per day, and 78 lb. straw per week for chaff and bedding. In winter one pint of linseed and a peck of bran were given in the form of a mash, while in summer a certain quantity of grass was allowed in lieu of some hay or oats.

There is, of course, some variety in the kind, as well as in the quantity, of forage allowed in different horse establishments, but these two examples will give a general idea of what is usually allowed for the heavier horses. For smaller horses undergoing regular but hard work within a brief space—such as omnibus or tramcar horses—a smaller quantity of forage is generally given, ranging from 26 lb. to 32 lb., the proportion of grain varying from 13 lb. to 20 lb. The chief tramway company in London, for instance, gives: maize, 13 lb.; oats, 3 lb.; beans, 1 lb.; hay and straw in chaff—of the first 7 lb., the second 3 lb.; while the Edinburgh Tramway Company allows: oats, 8 lb.; maize, 4 lb.; beans, 4 lb.; hay, 14 lb.; Marshlam, 2 lb. In Paris the horses were receiving in 1886: oats, 5·50 lb.; maize, 12·92 lb.; beans, 10 lb.; bran and carrots, 50 lb.; hay, 8·62 lb.: straw, 7·30 lb.

The scale of rations for our troop-horses is usually 10 lb. of oats, 12 lb. of hay, and 8 lb. of straw per day, the latter being used for litter, and the hay is rarely chopped. When in camp 2 lb. to 4 lb. extra of oats are allowed, but no straw.

For hunters during the season the grain allowance is high, from 16 to 18 lb., with 8 to 10 lb. of hay, and 2 or 3 lb. of carrots per day. Frequently 1 or 2 lb. of beans are added to the ration.

Carriage-horses, when hard-worked, should be fed like hunters; ponies and under-sized horses do not require so much hay or grain.



When horses require to be fed during work, grain should be chiefly given, the bulky food being allowed at resting time—as at night. Care should be taken not to overfeed horses at any meal; and if the grain is not mixed with chopped hay, then it should be given alone, and the hay allowed afterwards.

Horses should not be fed, if it is avoidable, immediately before going to work, but sufficient time should be given for digestion to be well advanced before exertion is undergone. Food should be allowed during the day at intervals of three or four hours, and long fasts ought to be avoided, as well as hurried feeding. The nosebag system is an excellent one.

The former leads to imperfect mastication and over-distension of the stomach when food is offered, with consequent indigestion; and the latter has a like result. When a long fast is unavoidable, then a quantity of warm gruel or a little mash should be given, to be followed by the ordinary feed shortly afterwards.

An important point in feeding is to apportion the feeds in such a way that each will be consumed at the time it is given.

Care is necessary, adds Dr. Fleming, in allowing water to horses. It should never be given soon after feeding, but always before it, especially if the food is grain. If the horse is very thirsty, the thirst may be assuaged and the feed given a short time afterwards; if any more water is needed, it ought not to be offered within two or three hours after feeding. When horses can always have access to water, they drink less, and so run less risk of indigestion and colic than when it is only offered at long intervals. It is, therefore, the best plan to allow them to have water, like their food, frequently; if properly watered, they will not drink any more than is necessary for them. While undergoing severe exertion, they should receive very little. There are circumstances when it may be necessary to restrict an unlimited supply of cold water, as when a horse is exhausted from fatigue, has undergone prolonged abstinence, or when very cold, or even excessively hot. In such cases, a small quantity only should be allowed until the body is in a fit state to receive more; though a larger quantity may be given if it is tepid, or in the form of gruel.

It should be unnecessary to add that water given to horses ought to be clean and fresh.

So much of what has been already said on the subject of soiling cattle is applicable to the SUMMER FEEDING of horses, that but few observations are requisite. The common modes are—1st, to turn them out on pasture; 2ndly, to feed them, in the field, on artificial grasses, either cut or grazed; and 3rdly, to soil them on green food, in the stable or yard. Each method has its advocates; and the choice must, in great measure, depend upon the convenience, as well as the judgment, of the farmer.

The *first* method is, properly enough, adopted on farms that have a large proportion of grass land, and are not within reach of a market for hay. Horses thus kept are, perhaps, more healthy than in any other way, if the herbage is abundant and good; but one great disadvantage attending it is the time lost every morning in getting them together.

To obviate this, their range should be limited, and where the enclosures are large, they should, if possible, be divided up by hurdles, by which means also the grass will be less trampled, and the cattle will have the advantage of fresh pasture. As some horses will eat greedily when first turned on to fresh pastures—so greedily as to bring on indigestion, and even to cause death—it is advisable to gradually accustom them to green food for some days before turning them out.

The *second* method is customary on arable farms; and, when properly conducted, is a most advantageous mode of disposing of green crops not intended for hay. The horses are, however, too commonly turned on the land to graze, and thus destroy a great deal more food than they consume. Some farmers, indeed, argue that the vegetable matter thus trodden into the soil, saturated with dung and urine, forms a complete coat of manure without the labour of spreading; but they forget the advantage that would be derived from feeding double the number of stock, and the return to the land of double the quantity of dung. It is, in fact, a slovenly and wasteful practice, that cannot be too much reprobated; and it admits of less excuse, as it can be avoided by hurdling off the quantity intended to be used each day, and giving it cut, in cribs, or even on the ground.

The *third* method is a more economical practice, so far as regards consumption, than if the food were given cut in the field, but it is attended with the expense of cartage to the homestead; it is far more profitable in respect of manure, for the fertilising properties of the dung and urine, when these are dropped in detached portions upon the land, are liable to become dissipated by the sun, whereas if dropped on straw or litter they create a valuable manure and an abundance of it. Horses also are more in readiness for their labour when kept in the farm-yard than in the field; they are cooler when under shelter, and are less exposed to the annoyance of flies, than when abroad in hot weather. The purer air of the fields is no doubt much better for the health of all cattle, and they are found to feed better in the open air than when confined; but the superiority of the above mode, in regard to manure, is incontestable. The only way, perhaps, in which soiling in the field can, in that view, bear a comparison with it, is when the land under the green crop is intended to be immediately ploughed and sown; as, for instance, when turnips follow tares, in which case, if there is sufficient stock to eat off a large quantity at once, it may be advisable to feed them on the ground, and plough the manure under, before its value is exhausted.

Experience has demonstrated the advantage of crushing and bruising grain, and even of grinding it, and cutting or chopping fodder; these processes facilitate digestion by bringing the nutritious portions of the food more completely in contact with the stomach, and thus enabling them to pass with greater ease into the system and afford the animal more sustenance, while to the farmer they are the means of effecting a considerable saving—considerable, if we only regard the actual amount of hay, straw, &c., which is wasted when these ingredients are given in their natural state; considerable, if we look at the quantity

of undigested grain voided in the excrements of every horse fed on whole oats or corn; and still more considerable, when we mark the difference in the condition of those horses which are fed on crushed, and chopped, and cooked food, and those which get their allowance in its natural and crude state.<sup>1</sup>

The feeding of an ordinary farm mare during the hardest period of work in winter and spring is well illustrated, says Mr. Macneilage, on farms in the Glasgow district, where there is much heavy carting. The allowance per head per week is two bushels bruised oats, one bushel maize, and cut hay. Each animal gets nightly a pailful of boiled food, consisting of barley, turnips, and chaff, mixed in a large cooler, with one basketful of bran, and as much good rye grass or timothy hay as each horse can eat. The use of boiled food is, however, dying out in the west of Scotland, and on many farms it is never used. Horses winter much better, and are less liable to colic, without it. In Ayrshire, in districts where early potatoes are raised, and high farming generally is the rule, the morning feed for each work-horse at 5·30 is 3½lb. bruised oats, 3½lb. maize, and 3lb. chopped hay, mixed. At noon a repetition of the same. At 6·30 p.m., 3½lb. bean meal, and 3½lb. chopped hay, mixed together and saturated with boiling water, five hours before feeding time. At all times, in addition, the horses have an abundance of good hay in front of them.

At Udny, Aberdeenshire, the following are considered good rations for a work-horse: Feed six times a day. 5 a.m., mash, consisting of 2½lb. oats and 3½lb. bran: 5.45 a.m., 2lb. oats: 11 a.m., 2½ lb. oats; 12 noon, 2½lb. oats; 6 p.m., 2½lb. oats and 3½lb. bran in mash; 8 p.m., 8lb. raw turnips. Hay uncut *ad libitum*, and oats always bruised.

Work-horses should be fed at least four times a day, and from 14 to 16lb. of grain, with as much fodder as they can use, is a good allowance for each animal.

Of equal importance with the feeding of horses is the MANAGEMENT of them, when their daily labour is performed; but concerning the best mode a considerable difference of opinion prevails. By some it is remarked, that the keeping of horses in stables, with separate stalls for each, so that they may feed quietly and be expeditiously harnessed, is in every respect the preferable method, provided the stable is well ventilated. By ventilation we do not mean the admission of draughts of cold air from various quarters, as is too often the case in carelessly-constructed farm stables, but that means shall be taken to facilitate the removal of the heated and impure air, as by tubes, funnels, or perforated ceilings; and where the hay-loft happens to be over the stable, every precaution should be taken to prevent any of the foul air from permeating into the loft and saturating the food with its noxious gases.

Others, on the contrary, assert that sheds, open to the front, with racks and mangers fixed below, and having a pump and cistern, as well

<sup>1</sup> Veterinarian, 1849, p. 237. Journal of the Royal Agricultural Society, vol. ix. p. 250.

as a small yard in which the horses may run at pleasure, are superior to the stable method; because, if well littered, the horses will not require any other dressing than is usually given by a farmer's servants. Since, however, these animals are very susceptible to cold, it is most advisable, in exposed and bleak situations to keep them in stables; though, in mild and sheltered places, the shed-system may at times be found the more profitable. Where the practice has been followed, it has been generally found successful; and horses thus managed are by some considered not only to be more healthy than those kept in stables, but also to attain a greater age. In stables every horse should have a stall to himself, and that as roomy as possible; not less than six, or even eight feet in width. Thus a greater degree of supervision can be maintained; it will be instantly perceptible when an animal is off his feed, and each will get his own due share of food. There should be windows to admit light and air to the stables when required, but these should be furnished with shutters, for many horses will not lie down to rest while the stable is light.

Carters are often very negligent—not, indeed, of feeding their horses, for they will seldom hesitate to steal corn for the purpose of pampering them—but of that care which requires labour; and masters too commonly permit their servants to manage the teams nearly as they please. The consequences of this are frequently injurious to the health of the animals. It is not necessary that farm-horses should be groomed like hunters. Too free a use of the currycomb might indeed be rather prejudicial, in winter, to horses that are constantly employed at slow work for many successive hours in all kinds of weather, for it would take away too much of the long coat with which nature provides them as a protection against the inclemency of the season; still this argument will not hold in face of the necessity of cleanliness. A certain degree of grooming is highly desirable to promote health and to keep active the functions of the skin; and no dieting, no amount of food ever so well chosen, will give horses that sleek look of condition they should have, unless they are also regularly rubbed down with wisps when they come in, and well brushed, and their legs and feet cleaned, before they are shut up for the night.

The fetlocks of cart-horses (though not of Suffolks) are usually covered with a profuse quantity of hair, and, on flinty soils, a moderate portion of it forms a very desirable protection against injury; but if not daily cleansed from the dirt which is collected, the accumulation at length occasions that unsightly and stubborn disease "grease" (see page 572). In like manner, perspiration mats the coat, and clogs the roots of the hair with scurf, and produces eruptions on the skin that are often difficult of cure. It should, therefore, be a settled rule, that, whether the horses are kept in the stable or not, their feet should be regularly washed on their return from labour, and dried, and the legs well wisped or hand-rubbed, provided the men can be relied upon to do this. The friction tends to restore warmth to the extremities of the tired animal, and relieves swellings or soreness. Merely to wash off the dirt from the fetlocks and feet, and leave them to dry gradually, is

even more pernicious than to let the animal remain in the state in which he comes from work.

The hoofs should be occasionally oiled and stopped. For the latter purpose cow-dung is an application in common use. Clay hardens, and, soon becoming dry, heats and otherwise injures the hoof; but the common felt stopping, now sold by all saddlers, is far neater, and quite as effectual when merely wetted. The feet require more care than is usually bestowed upon them in farm stables, and scarcely anything occasions them more injury than the reprehensible practice of letting horses stand upon soiled litter until it ferments; and the common, but very mistaken economy, of not shoeing sufficiently often.

Some persons go into the opposite extreme in the first respect, and keep their horses standing the whole of the day upon the bare stones, the litter being thrown up under the manger; but, the pavement of stables being often laid in too slanting a direction the horses are placed in an unnatural position, which strains and injures the muscles of the legs, while the pungent effluvia of the litter ascend more readily to the eyes and to the racks, and the foundation is laid of blindness. The slope of the paving of the stall should not exceed three inches in nine feet. If litter is too scarce to allow of that part which has become saturated with urine being thrown into the farm-yard, it should at least be carried out and dried, every morning when the weather will permit of it, and a little fresh straw laid for the horse to stand on.

The state of the bowels should be constantly attended to, and when hard meat is given it is an excellent practice to allow a cold bran mash every Saturday night. If, also, on that day the field labour were abridged an hour or two, and the time devoted to cleaning and oiling the harness, it would not be thrown away. The stable should be kept not only clean, but sweet; and fresh air should be constantly admitted, for the horse has a strong dislike to every offensive smell; besides this, the pungency of the vapour arising from fermented litter occasions injury to the eyes as well as general disease. Powdered gypsum strewn over the floor is said to absorb some portion of the ammonia arising from the litter, and save the animals much annoyance, and Mr. Richardson recommends, as a speedy and effectual disinfectant where the fumes of the ammonia are very pungent, that a shallow dish of muriatic acid (hydrochloric acid, spirits of salt) be set in the stable.<sup>1</sup> But a more simple and equally efficacious means of absorbing, or deodorising, this pungent gas, has been suggested, viz., the making two small excavations, about ten or twelve inches deep, one at the centre and one at the end of the stall, and three parts filling them with powdered peat charcoal, which attracts and absorbs the ammoniacal gas, and when saturated forms an exceedingly efficient manure, especially for flowers.<sup>2</sup> The interior of stables should be lime-washed twice a year,—all, that is, save the wood work, and this should be well scrubbed with a brush, soap and warm water being employed. If

<sup>1</sup> Richardson on the Breeding, Management, and Varieties of Horses.

<sup>2</sup> *The Times*, August 7, 1851.

sheds are used, care should be taken that the litter is dry, and that the roof effectually keeps out the rain; and, above all, it should never be forgotten that "the eye of the master fattens the horse," or, as Gervase Markham puts it, "the best provender for the horse [is] the master's eye."

In an inquiry instituted by the "Live Stock Journal" into the feeding and management of horses, information was sought upon the following points:—

1. Feeding of mares prior to and after foaling; times of feeding; varieties and quantities of food, &c. 2. Management and feeding of foals. 3. Feeding of stallions during service season and during off season. 4. Management and feeding of young stock. 5. Summer and winter treatment of horses at work. Amongst the replies are several of high practical interest.

Mr. George Rodger, Newton Bank, Preston Brook, Warrington, Cheshire, says:—

1. *Feeding of Mares prior to and after Foaling.*—As my mares are kept solely for breeding (not for work), their feeding will differ considerably from that of those which are worked more or less regularly. I find it advisable to let them have the run of the grass fields winter and summer, except when there is snow on the ground; at such times, and throughout winter, when there is little grass on the fields, each mare has a bucket of boiled food morning and evening, and perhaps a feed of mixed corn besides. The boiled food consists of chopped hay, bran, turnips, and barley, with a few beans, and is allowed to grow cold before being given. The mixed corn is usually crushed oats and Indian corn with bran. Besides this they have hay in their racks. For a fortnight before foaling, if not altogether on grass, it is safer to give more and more bran, gradually deducting the more heating and fattening substances, until on the day of foaling the mare is almost solely fed on bran. After foaling, give oatmeal gruel, and later, bran mashes, gradually adding the boiled food in larger and larger quantities. If the mare foals before June, and more especially in the earlier months of the year, when east winds are prevalent, the utmost care must be taken to keep the loose box warm and prevent cold draughts getting into it. In every case where a foal has died with me, congestion of the lungs has been the cause, brought on by cold.

2. *Management of Foals, &c.*—It is always to be desired that the mare be watched when about to foal, and remained up with until the foal begins to suck—so many fatal accidents may happen, such as wrong presentations, foal smothered in sheet, foal lain upon by the mother, if she gets up and goes down again, &c., &c. If the foal is an early one, and in my opinion the earlier the better, it is an excellent thing to encourage it to eat a little of its mother's boiled food, and this it can do within a fortnight after it is foaled; thus, when the time comes for it to be weaned, it takes to artificial food quite kindly. As a rule, I allow my mares to wean their own foals, unless this is not done before seven months are out; in such cases the mare is kept in the house for a few days, and afterwards in a field at a distance.

Foals should be handled from the day they are born, and for this purpose a small halter should be put upon them to enable them to be held and walked about. Throughout their first winter it is advisable to stable foals at night, giving them the same food as that for mares.

3. *Feeding of Stallions, &c.*—I am quite sure, if men were only good enough judges, it would be far better to keep stallions only in a fair "store" condition on mixed meal and soft food; but as, unfortunately, the rarity is to find a man who can judge a leanish horse, for the sake of getting custom the horse has to be fattened up. To do this he should be fed five or six times a day—not much at once, and with as much variety as possible. When on service, he should have more hard feeding, and *vice versâ* during the off season—the hard feeding being proportioned to the travelling and work he has to do.

4. *Management of Young Stock.*—This is in every way similar to what I have written under the head of mares, as far as fillies are concerned, and colts until they are one year or one and a half years old. At that age these latter are taken into boxes with courts attached, in which they are allowed to run about, each colt having a separate box and court. They are then also regularly exercised. As a rule, each two-year-old colt has fifteen or twenty mares, and, while this pays for his keep, it does him no harm. One point I am very particular about with all my stock, especially the young ones,—it is that their feet be pared down level with the sole once a month in summer, and once in two or three months in winter, allowing always the frog to touch the ground; thus, without shoes, and the frog touching the ground always, there is no fear of contracted feet.

Mr. Henry Moore, Burn Butts, Cranswick, says:—The questions are difficult to answer, as the quantity of food required varies so much according to the horse or mare that has to be fed, and this can only be decided by the feeder of the animal. (1.) With regard to treatment of brood mares, I may remark that they should sleep in the box they are expected to foal in a week, at least, before foaling. We generally feed them as usual until they have foaled; then we give them two feeds of oats, a few carrots, and beans for the first week or two, as we think best; then the same quantity of oats, about a quarter of a bushel a day, mixed with wheat chaff, or chopped clover, and of course get them out to grass in the day as the weather will allow. (2.) We wean our foals about the second week in October, and as we accustom them to eat corn with the mother, we do not change the diet much, but make it as liberal as possible until we can get them turned out to grass. (3.) The feeding of stallions during service I think almost impossible to give an opinion upon, as different treatment is required for different horses. I think it the best plan to give oats mixed with beans, a few carrots, and a very small quantity of good dry white peas; the beans and oats we always give damped with a little water. We never give cold water to drink, but always add a little warm water to take off the chill. (I think this most important.) In the off-season we give chaff and oats twice a day, and any green food we can get in summer, and carrots in winter. (4.) Of course

we get our young stock to grass in summer; in winter we feed them twice a day with chopped clover, pulped swede turnips, and carrots mixed with crushed oats; and it is very important for young stock to be kept improving by beginning to feed them as soon as the grass begins to fail—say, by giving a little corn (oats) about the second week in October. (5.) Horses at work (cart-horses) we allow about half a bushel of oats, mixed with either chopped clover or wheat chaff. Of course in summer we give them green food, what they will eat, and less corn.

Mr. Arthur Ransom, Hitchin, says, as regards the feeding of cart horses:—The best and safest food for brood mares and young stock is *good* grass whenever it can be got; but during winter and early spring artificial feeding is also necessary. I find a mixture of bran, pulped roots, and chaff, with a small allowance of the best linseed or Waterloo round cake, and perhaps a few crushed oats, given twice daily on the pasture or in the yard, very useful and safe. The addition of the linseed in the cake helps the digestive organs, and renders them less liable to irregularities causing stoppage and inflammation, from which the heaviest losses of horse breeders often occur. Stallions, of course, require a more generous diet in the covering season; a small quantity of linseed in some form or other is a very useful addition to the oats, beans, or peas which form their main feed. My working mares get during the winter two bushels of crushed oats, mixed with pulped mangel and chaff; also from one to two trusses (56 lb.) of clover or sainfoin hay per week, and when doing the heaviest work half a bushel of split beans in addition. In summer, the pulped roots are replaced by green rye, oats, and tares, chaffed, and the corn considerably reduced. Sometimes they are turned out to grass at night and on Sundays, but they are more often kept in yards. I notice almost invariably that high feeding of mares during the covering season means a short crop of foals the succeeding spring. A cool and natural dietary is a necessity where the main object, as with me, is to secure a number of good healthy foals. The feeding of foals after weaning is most important, and plenty of good bran with a few crushed oats or Waterloo cake, given once or twice daily, is a great assistance to them.

Sir Charles W. Strickland writes:—I have no definite system of feeding or management either of mares and foals or young stock. I go upon the principle of keeping all animals not in work as much out of doors as possible, and taking care that all animals in the stables should not have too much corn and too little work, which is the cause of nine-tenths of the evils that horseflesh is liable to. Stallions I ride or work in harness, just as I do other horses, and consider that it is the only way to keep them healthy and good-tempered.

Another competent authority says:—The mare during the latter period of gestation should be well fed and should have plenty of daily exercise. Idle mares may be kept at grass; if so, they should have a shelter-hovel, in case of wet or severe weather setting in. Mares who have the range of a large pasture will sufficiently exercise themselves. During the winter and spring months 6 lb. crushed oats,



2 lb. bran, and a small quantity of hay-chaff should be placed in a manger in the shed daily. If you expect a well-developed foal, the mare must be kept in good condition. Starvation is frequently the cause of abortion. Nature is sure to assert her authority, and is prone to resent liberties. The draught mare may be worked with safety and advantage up to the date of foaling, provided she is entrusted to careful hands. Immediately after foaling the mare should be fed for the first week on sloppy food, consisting of oats, swedes, and cut chaff. The whole should be cooked and given in a lukewarm state. The working mare and foal should be kept in a roomy box for the first few days. Outlying mares should also be shut up for a time, otherwise the foal is in danger of accident. The food should be such as will encourage the flow of milk. If the mare is well managed previous to foaling, the young animal will not require any medicine. The docking of cart foals is a barbarous practice, and should not be encouraged. The War authorities will not purchase a docked horse at any price, and in this, I think, they are right.

It is idle to expect to raise good foals where the mares are constantly worked: the milk of a worked mare is thin and watery. It is a good policy to feed the mare while suckling her foal. The young animal soon learns to eat. A few crushed oats and a little bran are the best to begin with; pure linseed cake may be used in small quantities. The foal should have a separate manger constructed in such a way as to prevent the mare from reaching the food. The foal should be early taught to lead; a tight leather headstall is worn, and this enables the groom to catch the foal without much trouble; to this he attaches the leading rein. A lesson should be given at any convenient season. After weaning, a liberal diet should be provided. We have tried unrefined cod-liver oil mixed with the meal and chop; they take to it readily, and thrive well. A small quantity is used, and the additional cost is trifling.

The stallion during the service season should be well kept. A mixture of boiled beans, oats, and barley is not so heating as raw corn, mixed with a small quantity of bran and nice sweet hay chaff. The quantity necessarily depends on the temperament of the animal as well as the constitution; irritable, ill-tempered horses consume more food and do not thrive so well as a docile animal. 12 lb. to 15 lb. of boiled corn will be sufficient in most cases. Oatmeal gruel and raw eggs may be given to a horse who has a heavy season. I have to-day seen a horse who has already served ninety mares, and, although travelling a wide circuit, he is in quite as good condition as when he started.

Young stock require plenty of breathing space, a liberal supply of pure water, and some nourishing food. They thrive best when kept in quiet, well-sheltered situations, and when they also receive a daily allowance of nourishing food. Except on the best lands, artificial foods should be used in the summer as well as in the winter. Young horses grow best when grazed thinly with other stock. Where a number are kept together in the same field, they are sure to graze the



The distance travelled in each instance was, at the slow pace, within a fraction of twelve miles, and at the quicker, sixteen miles; and it thus appears that the additional quantity of land ploughed was about one-third, or in nearly equal proportion to the increase of pace. For a mass of "facts and figures" connected with the horse-power of a farm, we refer the reader to the useful work of Mr. John Chalmers Morton, entitled "The Labour of the Farm."

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## CHAPTER VIII.

### OF ASSES AND MULES.

**A**LTHOUGH so little employed in this country as scarcely to be enumerated among agricultural stock, yet when reared with care and properly treated, Asses and Mules may be rendered extremely serviceable, and are therefore deserving the farmer's attention, if not at home at least in the Colonies.

I. ASSES (see fig. 99), when domesticated and well used, are tractable and patient, and far more attached to their master than the horse generally is; although it cannot be denied that, under the brutal treatment to which they are too often subjected, they become slow, and stubborn, and headstrong. No animals, perhaps, are capable of supporting greater burthens or drawing heavier weights, in proportion to their size, than asses, on which account they are principally worked in conveying hucksters' goods. They have been employed, to great advantage, in drawing waggons and other carriages.

A gentleman, Mr. Worthington, worked four asses at plough, yoked two abreast, driven in hand with reins by the ploughman, and found that they were more than masters of the work required from two common farmer's horses of a slight kind. Mr. Worthington esteemed an acre a good day's work; but in cross-ploughing they would do more. At such work two asses were sometimes enough, and two were also sufficient in turning the furrow at potato-planting. The soil on which these animals were employed was a loamy stone brash of medium but varying depth, and tenacious rather than light.

"In respect of consumption," concludes Mr. Worthington, "I can only add, that the ass is a temperate eater; and that he appears to thrive best when left at large to his bramble-leaves (which flourish almost through the whole winter), with a little corn at his breakfast, and at the close of work; and a bite of hay at noon at his gears; and he may also be safely trusted abroad with his associates, as, unless in his rutting season, he scarcely ever strays. He loves grains, and will eat them freely; and is fond, beyond any other food, of the culinary roots, and in particular of potatoes and carrots."

To this it may be added, that he appears to be exempt not only from most of the contagious disorders often so fatal to other cattle, but from the greater number of all ailments ; that he will undergo great fatigue ; and that he is very long-lived. It may, however, be doubted whether his qualification, as a beast of draught, will often introduce him into farmers' teams ; but, as a beast of burthen, he may be rendered extremely useful, in clearing green crops from land that will not allow of carts in a wet season, and in many other things about a farm, more especially in hoeing.

There are two, almost distinct, varieties of the ass : the one grey ; the other brown, and sometimes approaching to black. The former is the larger and the stronger, but he is also the more dull, and seems to

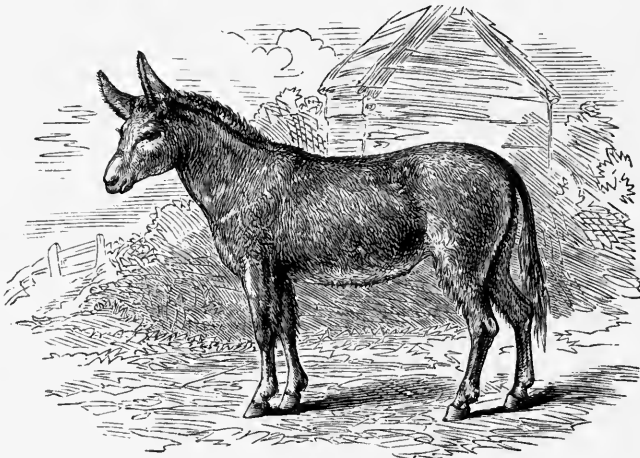


Fig. 99.--The Ass.

merit much of the character for stupidity unjustly attributed to the whole race. The latter is of a light and even handsome form, and lively disposition, and is particularly suited to the saddle, for which purpose he is very generally used in Portugal and Spain, where he is bred of a very large size ; but he there wears a very different appearance from that of the wretched animals often so shamefully used at our fashionable watering-places. He is first saddled with a pack, which covers the entire back from the shoulder to the loins, and is raised and peaked upwards at the pommel, to prevent the weight of the rider from pressing forward ; on this a smaller cushion is laid, and secured by a kind of arm-chair, with legs curving round the sides of the saddle, and having a small hanging-board instead of a stirrup, to rest both the feet—the lady sitting sideways. The entire caparison is covered with cloth, or velvet, or morocco leather, of the gayest colours, and the breast-plate and bridle being embroidered in parti-coloured worsted, the whole, when placed upon a well-fed and well-broken-in brown male ass, forms a set-out that is very far from being contemptible.

Asses require very little more attention in rearing than occasionally to pare their hoofs, which are otherwise apt to grow long at the toe, and become narrow at the heel, thus rendering them liable to stumble. They are naturally very sure-footed, and if trained with gentleness they will be found exceedingly docile, their intractability being generally the effect of ill-treatment.

"Farmers," says a writer in the "Scottish Farmer," "have paid far too little attention to the ass. There are many jobs about the farm which one or a couple of donkeys could perform to the saving of a horse; and, as an ass could be bought for a tenth or a twentieth of the price of a good horse, and fed at a fourth of the expense—on the coarse herbage, indeed, which all other animals on the farm are too

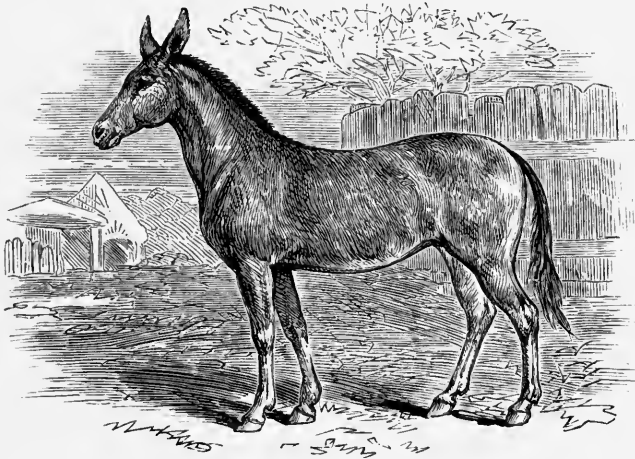


Fig. 100.—The Mule.

nice to taste—the balance in favour of keeping two, instead of an extra horse, would be something considerable." It is gratifying, however, to know that much greater attention is now being paid to the breeding and rearing of donkeys or asses. They are frequently exhibited at our shows,<sup>1</sup> and special exhibitions are sometimes given of them. This with the valuable prizes offered has done much, and is likely in the future to do more, to bring before farmers and others a superior breed of this highly useful, although hitherto contemned animal. Sir George Elliot, of Aberaman, has been exceedingly successful in the introduction into this country of the Egyptian donkey. This breed is remarkable for its symmetry, its swiftness, and the beautiful colour of its coat.

<sup>1</sup> At the Windsor Show of the Royal Agricultural Society (1889), an exceptional section was provided for Asses (of any breed). The two prizes in the stallion class both went to Mr. C. L. Sutherland, Down Hall, Farnborough, Kent, the 1st for a black Maltese (Old Gozo) variety, the 2nd for a black Poitou-Maltese. In their report the Judges say:—"Seventeen Asses were entered for competition, eight Jacks and nine She-asses. They were of all sorts and sizes, and included specimens from Spain, France, Malta, Syria, and Egypt, besides one or two natives of England."

II. The MULE (see fig. 100) is a mongrel animal, between the horse and the she-ass, or the jack-ass and the mare. He is hardy, strong, and sure-footed, lives to a great age, and, being maintained at less expense than the horse, might be advantageously employed on farms. It is the only beast of burthen used in the South of Europe; and in Spain and Portugal mules are employed both for the saddle and in gentlemen's carriages. For the latter purpose they are bred of a large size, and sell at much higher prices than the horse,<sup>1</sup> as they not only live longer and are less subject to disease, but are found to go through more work and to stand it better. The common load for Spanish mules, in addition to a heavy pack-saddle, is 280 lb., or 20 stones, with which they will travel, for several successive days, at the rate of from thirty to forty miles per day. Their only food is barley, or Indian corn, and straw, upon which they are kept in excellent condition, and, when not ill-treated, will continue to labour for thirty, and even forty years.

Mules are very extensively used in Mexico, in carrying supplies to the mines, some of which are hundreds of miles from the base, and in bringing back the metal. Wherever vehicles can travel, mules are used in the waggons, diligences, &c., and they do their work excellently well.

It must be evident, from this slight sketch, that these animals might be rendered very serviceable for many purposes for which horses are now employed. They are steady pullers, standing well to the collar at uphill draughts at which horses would stand still, and are more muscular, in proportion to their size; but, not possessing equal weight, they cannot exert the same force. For ploughing land that is subject to be poached by heavy animals, for hoeing and harrowing, and all kinds of light road-work, they would probably be found a cheap and effective substitute for the expensive teams in general use.

The produce of the horse and the female ass is a different kind of animal from that which we have been describing, partaking more of the appearance of the horse and less of his valuable qualities. Strictly speaking, the term "mule" is applied to the offspring of a mare and a male donkey, whilst the produce of a female donkey and a male horse is called a "mute," a "hinny," or a "jennett."

Mules are generally incapable of procreation, though some exceptions to this rule are stated to have occurred.<sup>2</sup>

It is to be noted, in concluding this chapter, that more attention is now being paid to the breeding both of asses and mules, not merely for the farm, but more especially for general purposes. It is also gratifying to state that, in the treatment of these animals, much more humanity is displayed than was formerly the case.

<sup>1</sup> In Lisbon, a pair of carriage-mules have been known to fetch as much as 250 moidores, equal to 337*l.* 10*s.*; and a good pair can seldom be got under 150 moidores.

<sup>2</sup> See "Horses, Asses, Zebras, Mules, and Mule Breeding," by W. B. Tegetmeier and C. L. Sutherland, 1895 (Horace Cox). Also "The Penicuik Experiments," by J. C. Ewart, M.D., F.R.S., 1899 (A. & C. Black).

## BOOK THE FOURTH.

ON THE BREEDING, REARING, AND FATTENING OF SHEEP.

### CHAPTER I.

#### INTRODUCTORY AND COMPARATIVE VIEW OF THE DIFFERENT BREEDS OF BRITISH SHEEP.

SO far as historical records extend, the sheep has always been known in a state of domestication. Its fleece has provided clothing, and its flesh food, for man from the earliest times, and in all ages of which we know anything the sheep has been recognised as property.

The number of the varieties of sheep is remarkable, and is possibly in some degree a consequence of human cultivation for untold generations, under endless diversities of soil, climate, and circumstances. Naturalists differ widely in their classification. Some are content to divide the sheep of the world into three species, viz. :— (a) the *Ovis Ammon* or argali, the wild sheep of Asia and America ; (b) the *Ovis Musmon* or moufflon, found in southern Europe and northern Africa ; (c) the *Ovis Aries* or domestic sheep which abounds in Europe. Other naturalists treat as distinct varieties what under the foregoing classification are considered as sub-varieties, and in this way as many as thirty-two varieties are recorded, of which Europe has four, Asia fifteen, Africa eleven, and America two. The European varieties are (a) the Merino (*Ovis Hispania*) ; (b) the Common Sheep (*Ovis rusticus*) ; (c) the Cretan sheep (*Ovis strepsiceros*) ; and (d) the Crimean sheep (*Ovis longicaudatus*). In this work we are concerned mainly with the "Common sheep," and, except for a reference to the Merino, it will be unnecessary further to allude to other varieties.

There is no doubt that sheep were found in a domesticated state in England from the most remote periods of which we have any record, and several of our earliest writers testify as to the value of the wool of these original British sheep. Possibly, however, at the early periods we refer to, only the parent stock existed, whence have gradually arisen all those different breeds which divers crosses, and the effects of care, cultivation, and locality, have handed down to us in their present valuable forms.

During the past century an immense improvement has taken place in British sheep, and as a consequence most of the old local breeds have either been supplanted by others, or have been so altered in character by means of systematic crossing and selection as to have little but their name in common with their ancestors. Over the greater part of England the breeds of sheep divide themselves naturally into two great sections, viz., the Longwools, which are found chiefly in the rich lowland pastures and marshes, and the Shortwools, which are kept especially on the Downs and uplands. The former generally have been to a considerable extent indebted to the new or "Dishley" Leicester, as perfected by Bakewell, and the latter to the Southdown as improved by Ellman.<sup>1</sup>

But, in addition to these two classes, and to a certain extent overlapping each, there are the Mountain breeds, some of which are long-woolled and some shortwoolled, some whitefaced and some blackfaced, some horned and some polled. Foremost among the Mountain breeds of sheep we may take—

**THE BLACK-FACED MOUNTAIN.**—This is the most numerously represented breed in the British Islands. In Scotland the Black-faces form a large majority of all the sheep stocks of the country. It has been a matter of dispute as to whether the breed be of English or of Scotch origin, but the most likely theory is that they were originally natives of the southern and south-eastern counties of Scotland and of some of the northern counties of England. As early as the commencement of the eighteenth century, the village of West Linton in Peeblesshire was recognised as the principal market for black-faced sheep. It is a well-known fact that they have been the native breed in the south-eastern counties of Scotland and the northern counties of England from very early times, but at the present day the most prominent breeding stocks of Black-faces are to be found in the Midland Counties of Scotland.

For a time their popularity was on the wane on account of their wool being coarser in texture than that of either the Cheviot or the Leicester, and at the period when the relative price of wool as compared with mutton was much higher than it is now, a good many black-faced stocks on the higher grounds were displaced by Cheviots. But the long succession of stormy seasons which began in 1860 worked sad havoc among the Cheviot stocks on the higher and more exposed regions, whereas the black-faced stock came through these severe winters with much less loss. The greater hardiness of the Black-faces as compared with the Cheviots, which was abundantly demonstrated during the disastrous seasons that followed 1860, made them the favourite sheep for all the higher grounds in Scotland and the North of England, and the immense fall since then in the price of wool as compared with mutton, has removed any temptation to risk the

<sup>1</sup> Generally speaking the Longwools are white-faced, and the Shortwools black- or brown-faced.



stocking of high and exposed districts with any finer-woolled class of sheep.

“The hardy mountain breed,” as the Black-faces are called, can thrive on coarse and exposed grazings, where the other breeds are hardly able to pick up a living at all. Another potent cause of their popularity and wideness of distribution is the great improvement effected in the breed within the last forty years. Not only has the breed been modified for the better as regards symmetry of form, weight of carcass, and weight as well as character of wool, but the valuable property of early maturity has been considerably developed in them. In fact, it is no uncommon thing now to have them brought out fat at from 9 to 18 months old, where formerly they were rarely ready for the butcher



Fig. 101.—Black-faced Mountain Sheep.

till they were three years old. Black-faced mutton is equivalent to the “prime Scots” of the London market, and it always commands high prices in any market. Black-faced ewes are also frequently mated with Leicester rams to produce what are called grey-faced or “cross” lambs, and these are excellent, not only for fat lambs, but for fattening off as hogs, and like the Black-faces, they often command the highest price in the market.

The points of the black-faced sheep are easily defined. The face should be broad and full and strong at the muzzle, the colour of the face and legs being clean black and white, with the black predominating. The horns should be low at the crown, with a clear space between the roots, and should come away with a wide circle sloping slightly backward and quite clear of the cheek. The eye should be bright and lively, the neck strong and full, the shoulder broad and deep, with the chest wide

and full, and the point coming well forward. The ribs should be well arched and deep, the back broad and short, with full square quarters and strong thighs. The hocks should be turned slightly out when walking, and the legs should be flat and clean, with well-developed joints and broad full feet. The fleece should be deep, thick, and strong, of uniform quality all over the body, and of a kind to stand the wear and tear of age.

A good average flock will yield a "clip" of from  $4\frac{1}{2}$  to 5 lb. per head of unwashed wool. Tup hogs frequently clip from 8 to 10 lb. of wool, and the Overshiels ram Saul (fig. 102), which was first in the aged class at the Windsor Show, clipped  $16\frac{1}{2}$  lb. of wool the week after

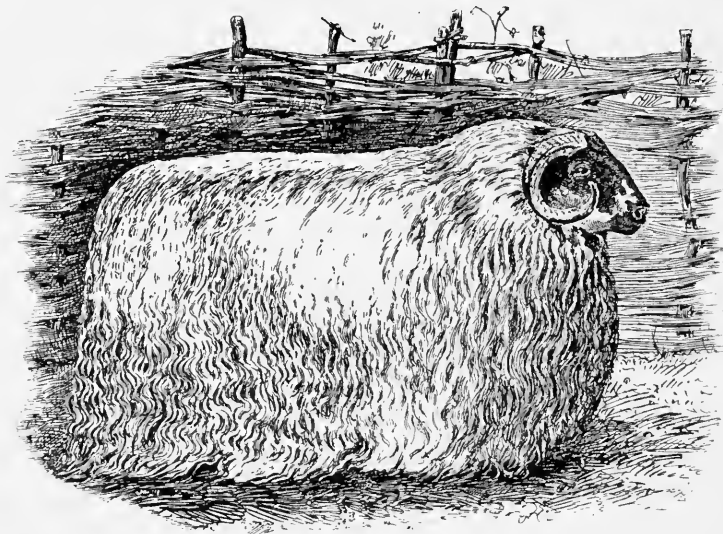


Fig. 102.—Black-faced Mountain Ram "Saul."

Winner of First Prize at the Jubilee Show of the Royal Agricultural Society at Windsor, 1889. Bred by Mr. John Archibald, Overshiels, Fountainhall, Midlothian.

that show. The ewes when fat will weigh from 15 to 18 lb. per quarter, and the wethers from 16 to 20 lb. per quarter.

Among the breeders whose enterprise and skill have contributed in an especial degree to the improvement and popularity of the breed are the Messrs. Archibald, of Overshiels, to whose flock the ram Saul belonged. These gentlemen breed and sell some 150 rams every year, and they have rarely if ever been beaten at the Royal or Highland Shows except by rams of their own breeding. Of the exhibitors of ewe stock at the national shows one of the most successful is the Duke of Argyle, whose flock is mainly headed by rams of Overshiels blood.

Two illustrations (figs. 101 and 102) are given of the Black-faced Mountain sheep.

THE CHEVIOT.—This breed of sheep (fig. 103) was originally a native of the Borders. When the British Wool Society was founded in 1791 Sir John Sinclair visited different parts of the country in order to find out what classes of sheep were most valuable for the production of wool, and he found on the Border ranges a breed of sheep to which he gave the name of Cheviots, because the best specimens of the breed were found on the Cheviot Hills. The early improver of this breed was a Mr. Robson, of Belford, who crossed them with the Lincolns, and in that way improved both the weight and quality of the fleece, but that was many years before Sir John Sinclair saw them and gave them their name of Cheviots. They were then called "the long white-faced sheep of the Border" in contradistinction to the "short sheep,"

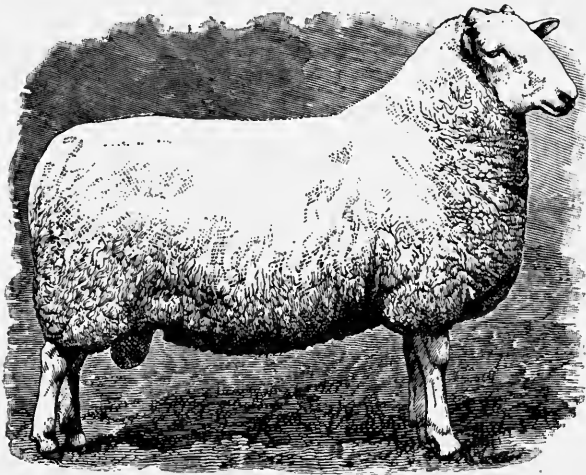


Fig. 103.—Cheviot Ram, "The Gentleman."

as the black-faced sheep were named, and even at the present day old shepherds talk of the "long sheep" and the "short sheep" by which they mean the Cheviots and Black-faces respectively. To Sir John Sinclair is due the credit of introducing the Cheviots into the North of Scotland, where a superior class of them is still kept in the counties of Sutherland and Caithness. About the beginning of the nineteenth century when wool was of more account than mutton, the Cheviots were more widely distributed than they are now, and a good many flocks of Black-faces on the higher grazings were sold off in order that their places might be filled with Cheviots. But the long series of very severe winters which commenced in 1860 completely decimated the stocks of Cheviots on the higher and more exposed grounds which were naturally fitted only for the hardy mountain breed, and since then the Black-faces have more than regained their former popularity while the Cheviots have been in comparatively few hands.

The points of the Cheviot are very similar to those of the Black-face

as regards the body, but the face of the Cheviot is white and all the females as well as most of the males are hornless, while frequently the horns found on the rams are more or less rudimentary. The wool of the Cheviot is also much shorter and finer than that of the Black-face. Unlike the Black-faces, Cheviots are generally washed before being clipped. The clip of a good average flock will yield from 4 to 4½ lb. per head of washed wool.

The popular type of Cheviot has passed through some mutations within the last half century. From 30 to 40 years ago there was a great rage for gaiety and style with a high thin face and a long neck—which latter feature is generally accompanied by a deficiency in chest—and in those days there was too little attention paid to the wool. Of recent years the tendency has been to run upon a small sheep with a small head, while the wool—despite the low price of that article—received more than its due share of attention. But again the popular type is being changed, and flock masters have come to realise the fact that the most profitable sheep is one with a good square well-balanced carcass of a medium size. There have also all along been two well-recognised varieties of the breed, namely the West Country type and the East Country type, which were so called on account of the locality in which these separate varieties were mainly found. The West Country type of Cheviot was distinguished by greater style, more prominent head, and relatively larger body, the East Country type being smaller in carcass, with closer wool and a less prominent head.

The greatest exponent of the West Country type of Cheviots was the late Mr. Jas. Brydon of Moodlaw and Kennelhead, whose show-yard successes placed him far ahead of all competitors. His biennial sales, which began in 1851 and ended in 1881, were always the leading event in the Cheviot year. The highest price ever paid for any of his rams was 185 guineas, which was given in 1867 by Mr. John Miller, the present tenant of Scrabster in Caithness, for a very superior ram. This price, it may be noted, is within 15s. of the highest price ever paid in Scotland for a sheep of any breed, the highest price on record for a Scotch sheep—195*l.*—having been paid by Messrs. Clark, Oldhamstocks, in 1873, for a Border Leicester ram bred by Lord Polwarth.<sup>1</sup> The most prominent exponent of the East Country type of Cheviot sheep was the late Mr. Thomas Elliot, of Hindhope. His sheep were of the type which is most in favour at the present time, and nearly all the leading prize winners of to-day trace back to them.

**THE EXMOOR and the DARTMOOR.**—These derive their names from the districts in the northern and western parts of Devonshire, where they are chiefly found. They are among the few true survivors of the old forest or mountain breeds of England. No doubt both breeds came from one stock, though the Exmoors—probably from having been less crossed—

<sup>1</sup> This was true when written in 1893. Since then, however, in 1898, Lord Polwarth sold a Border Leicester ram for £275, and Mr. David Buttar, of Corston, Coupar-Angus, a Shropshire ram for 310 guineas.

are now smaller than the Dartmoors. The Exmoors have white legs and faces, and black nostrils, and are horned, the horns curling more closely to the head than is the case with the Dorsets. The wool is short, and the fleece is close and fine. The Exmoors are delicately formed about the head and neck, but the carcass is narrow. They are exceedingly hardy, and when fattened at two and a half or three years old, arrive at 12 or 14 lb. weight per quarter.

For many years the Dartmoor has been crossed with the South Devon sheep, with the result that the present type of the former is altogether different from the old type. Mr. F. Ward, of Burville, Tavistock, informs us (February, 1892) that the Dartmoor sheep, as kept by the moorland farmers, was an animal with a white face, horned, and with long coarse wool. The wether sheep used to be kept on the Moor nearly all the year round, and were grown for the profit got out



Fig. 104.—Dartmoor Sheep.

of the wool; they were bad to feed and of a wild nature. There is another class of the Dartmoor kept by the farmers who only use the Moor for running their sheep in summer. This type has a face mottled with black spots on a white ground, the legs being similarly marked. These sheep have curly fleeces of much finer quality than those of the old Dartmoor; they are quick to fatten when matured, but not as lambs. The ewes are good mothers, and, when crossed with any sheep of a pure breed possessing quality—whether Down, Leicester, or Merino,—they produce lambs which fatten readily; so quickly, indeed, that there is a ready sale for the draft ewes for crossing purposes.

As regards the native Dartmoors of to-day, Mr. Ward adds, "I do not think they have ever been crossed with Leicesters or other breeds, for we find that if the sheep are crossed they do not live on the hills and other exposed situations." An exception is made, however, in the case of the South Devons bred near the Moor, on the south side, these being a finer description of improved Dartmoors. The Dartmoors seen

in the showyard would not, as a rule, live on the Moor, as they are too delicate.

The Dartmoor sheep (fig. 104), should be well-boned, with curly coat, rich skin, thick ear, good top-knot, and speckled face. A little horn is not objected to "as it shows constitution." The ewes are the best of mothers, and when crossed with rams of high quality, are good for producing fat lambs. The latter fatten readily when pure bred (as they are now considered pure) after they are twelve months old. The Dartmoors clip good fleeces—ewes that are kept fairly well about 10 or 11 lb. each, the wethers from 12 to 14 lb., rams from 20 to 30 lb. Mr. Ward had a ram in 1891 from which was shorn a fleece weighing 33 lb. The wool is all shorn in the yolk.

The country in which the Exmoors and Dartmoors are reared is generally surcharged with water after the autumnal rains; yet the hardy character of these sheep enables them to withstand adverse climatic conditions. Their summer pasture is scanty, and their winter food consists chiefly in what they pick up while ranging over extensive tracts of pasturage, with the assistance, in extremely severe weather, of a little indifferent hay obtained from the coarse herbage of the moors, and, perhaps, occasionally of a small supply of turnips, which, though sometimes cultivated, are, from the wetness of the land, often unavailable when most wanted. By means of their superior hardiness of constitution, and more especially their power of resisting wet, generally so injurious to sheep, nature has evidently adapted them to this soil. It is not, therefore, much to be wondered at that the attempts made to supplant them by more tender breeds, or to alter their character too greatly by crossing, have not met with success.

**THE HERDWICK.**—The sheep known as Herdwicks (fig. 105) are principally found in the mountainous districts at the head of the Duddon and Esk Rivers, in Cumberland, and in some parts of Westmoreland. The wethers and ewes are chiefly polled, and their faces and legs are speckled; but a great portion of white, and a few brownish black spots, are accounted marks of the purest breed. If any of them are found with horns and black faces, they are considered as descended from a cross with the common black-faced sheep. The wool is open, and generally intermixed with *kemps*, or hairs, excepting about the neck, where it is fine. The fleece weighs from 3 to 4 lb.

They are a hardy breed, well adapted to seek their food among their native rocks, which are in many places bare, and, even when covered, support but a thin soil. The herbage is mostly green, but heather is found on the summits. These sheep have no hay in winter, but support themselves in the deepest snows by scraping down to the herbage; and should any part be blown bare, they are sure to discover it. In storms they cluster together, in places where the snow is least likely to lodge. The lambs are well covered with wool from the time they are dropped.

The ewes are kept as long as they will breed, which is occasionally ten or even fifteen years. The wethers usually go off at about the same

age as the old Cheviots. Both ewes and wethers are sold as they come from the mountains, and slaughtered without being put on any better pasture. They are usually found sufficiently fat. The wethers weigh about 10 to 12 lb. per quarter; the ewes from 6 to 8 lb.



Fig. 105. Herdwick Ram, "Disraeli," and Ewes.

Winners of many Prizes.

The property of Mr. James Spencer, Murrah Hall, Penrith.

**THE LONK.**—This is another breed of mountain sheep (fig. 106) possessing great merit, and is the largest of any. They are black-faced, and are no doubt descended from the true black-faced breed, to which they have considerable resemblance. Their home is in the fells



Fig. 106.—Two-Shear Lonk Ewes.

The property of Mr. William Walsh, Gilstead, Bingley, Yorkshire.

of Yorkshire and Lancashire. They were thus spoken of at the Worcester Show of the Royal Agricultural Society in 1863:—"If the Lonks be as hardy as they are good, they must be the most valuable sheep for the hills that we have at present. Sheep which at fourteen

months will clip 10 lb. of wool and are full of mutton must be dangerous rivals for other breeds. The average clip of Mr. Peel's flock this year was 6 lb., and sold at 50s. the tod, and the breeding ewes and shearing rams ran on the hillside pastures as they liked." There was a small but very good collection of this breed at the Windsor Show of the Royal Agricultural Society in 1889, where their great size attracted general notice.

THE LIMESTONE breed was no doubt also originally an offshoot of the Black-faces, and may be found chiefly in the fells of Westmoreland. They are not much known outside their own district, but a small yet creditable display of them was exhibited at the Windsor Show in 1889. The sheep called "Limestones" in North Derbyshire are really Leicesters.

THE PENISTONE is a breed of sheep found on the borders of Yorkshire, Lancashire, and Derbyshire, on a heathy tract of land about twenty-six miles in length by twenty in breadth, and they are called the Penistone from the market-town of that name, where they are sold. They are described by Mr. Low as having wool of a medium length, of a silky appearance, but harsh and wiry, and weighing from 4 to 5 lb. the fleece. They have white faces and legs. The rams alone have horns, which are very large, lying close to the head, and projecting forward. The breed is now little known, and is apparently dying out.

THE WELSH MOUNTAIN breed (fig. 107) held at one time almost unchallenged possession of the Principality. There were no doubt two fairly distinct types, the one being found only in the higher mountains, and the other being more generally distributed. The higher mountain sheep was goat-like in appearance, and had a long tail and ridge of hair on the back, with the throat white and the face and legs black. They were very wild and active, and are said to be the original stock of the Radnor sheep, which is larger and heavier but still retains the black face and legs.

The soft-woolled sheep are the distinguishing breed of Wales. They are small and active, with white faces, and they furnish the wool from which the famous Welsh flannel is made. The flesh is firm and sweet, and has a high reputation as an article of food. Some attempts have been made to introduce other breeds, such as the Cheviots, into the mountain pastures of Wales, but without success. Of late years, however, the Welsh farmers in the lower and less exposed districts have introduced improved English breeds to a considerable extent.

Turning now to the improved breeds of sheep of which English flocks mainly consist, we find that they divide themselves, as already mentioned, on page 466, into two classes—the *long-woolled* and the *short-woolled*—the peculiar merits of which formed a subject of discussion for many years amongst agriculturists. Each class has valuable characteristics, and it was long thought that no effort to blend them would prove to be permanently successful. Nature seemed to have intended them for



different soils, and the short-woolled breeds, that thrive upon the bleakest hills, degenerated when removed into the rich pastures which are alone capable of maintaining the long-woolled types. Within the past fifty years, however, it has been found that by skilful assiduity and care it is possible to combine—as in the case of the Oxford Downs—the merits of both long-wools and short-wools in a distinct breed, which while not perhaps so well suited on the one hand to range the bleakest hills, or on the other hand to graze the fattest marshes, as are breeds specially adapted for such situations, is yet perfectly at

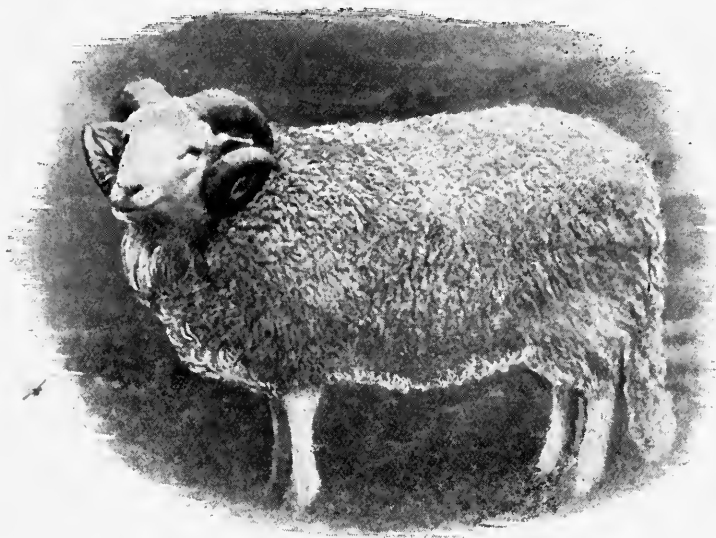


Fig. 107.—Welsh Mountain Ram.

Winner of First Prize at the Jubilee Show of the Royal Agricultural Society at Windsor, 1891. The property of Mr. John Jones, Llandudno, Carnarvonshire.

home under a very wide diversity of agricultural conditions, and unites in a remarkable degree the excellences of both its progenitors. The history of the origin of the Oxford Down breed is discussed subsequently (*see* page 490).

THE LEICESTER SHEEP may first be noticed among the *long-woolled* kind. There were originally three nearly distinct varieties:—

1. The *Forest Sheep*, which, though not confined to the open district of Charnwood Forest, were probably the common-field stock and original breed of the country. They were mostly polled, though some had small horns. They were generally white, but sometimes grey-faced, with legs of the same colour.

2. The *Old Leicester*, probably descended either from the still more ancient stock of Charnwood, improved by better feeding, or by crosses with rams from the rich pastures of Lincolnshire, or from a large-boned,

coarse-woolled breed, common to the Midland Counties. They were large, heavy, flat-sided, strong in the bone, coarse in the offal and pelt, and thickly covered with wool of a coarse quality. They were well adapted for the rich deep soils, upon which weight of mutton and of wool were more material objects for profit than fineness of quality; and, on such lands, the rams were commonly brought to weigh from 20 to 30 lb. a quarter, with a fleece of from 8 to 14 lb.

3. The *Improved Leicesters*, or, as they were long called, the Dishley Leicesters, are an improved kind of the old type. Their form is perfect, and their colour white. Their heads are clean and small, the neck is of a moderate length, and the breast full; the carcass round,

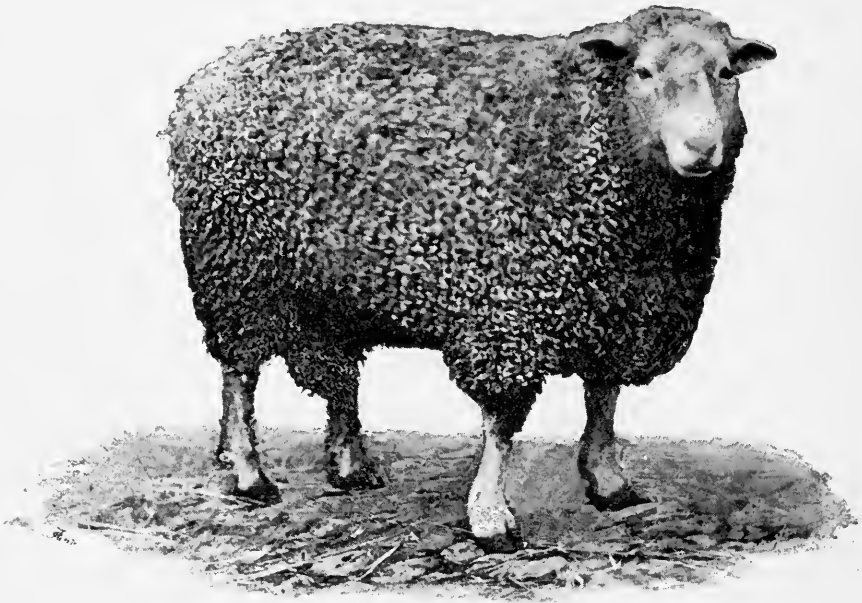


Fig. 108.—Leicester Ram.

The property of Mr. T. H. Hutchinson, Catterick.

with broad, straight back, and the belly also straight. The bone is all very fine, and particularly small in proportion to the size of the animal; the pelts are thin, and the wool is long and fine, and averages 7 lb. and upwards to the fleece. They are of a quiet disposition, fatten early and kindly, and are capable of being brought to a great weight, the fat wethers commonly weighing (when shear-hogs), 25 lb. per quarter, and the ewes 22 lb.

The introduction and establishment of this breed was due to Mr. Bakewell of Dishley, who by selection succeeded in producing an animal even more valuable than that which we now speak of as the Leicester Sheep.

During the first half of the last century there were few districts

into which the improved Leicester did not penetrate, and probably many of our present English breeds have at one time or another received a greater or less infusion of Dishley blood. In more than one case the free use of Leicester rams on a local stock resulted in the establishment of a new breed, which has for years been able to maintain its position without further admixture, and whose supporters are indeed now apt to repudiate the influence to which their fathers were indebted.

The following is a concise description of a Leicester sheep (figs. 108 and 109):—Head rather long, tapering towards muzzle, projecting horizontally forwards; eyes prominent; ears rather long, thin, pointing

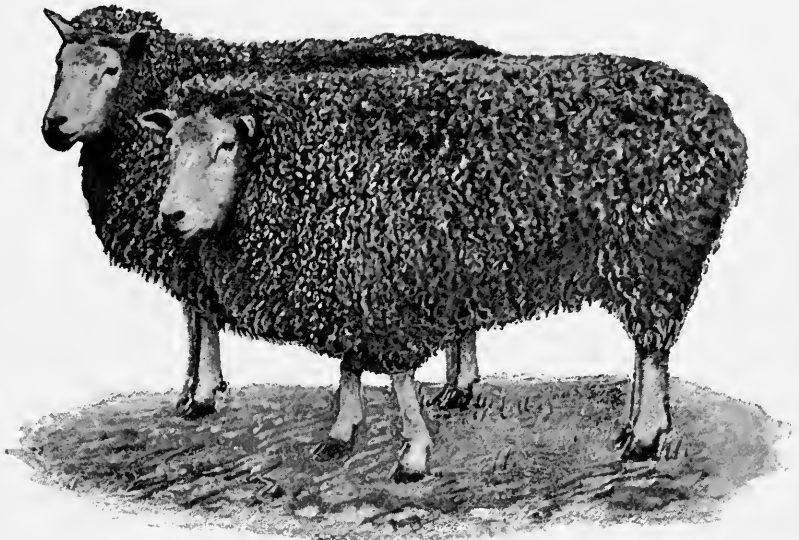


Fig. 109.—Leicester Ewes.

The property of Mr. Teasdale H. Hutchinson, Manor House, Catterick, Yorkshire.

backwards; neck full and broad at base, tapering towards head; breast full and broad; shoulders broad and round; arm fleshy to the knee; legs fine and clean, not coarse, of moderate length, and standing wide apart; barrel deep and round, ribs well arched from the spine; the line of the back and belly regular throughout, but the sides diminishing in width towards the rump; quarters long and full, muscles extending down to the hocks; thighs wide and full; pelt moderately thin and soft, covered with a good quantity of white wool, not so long as that of some breeds, but finer.

THE BORDER LEICESTERS are a direct off-shoot from the Dishley Leicesters of Bakewell. In the year 1767, Messrs. George & Matthew Culey, one or both of whom had been pupils of Bakewell,

migrated from the Tees to the Tweed, and took with them a flock of the improved Leicesters. There is a dispute as to whether the breed was or was not kept pure, some contending that there was a certain admixture of Cheviot blood. Whether this were so at first or not, it is certain that the Border Leicesters have for a century or more held a foremost position in the Scotch Lowlands. The rams are every year in great demand, and at the auction sales the highest prices are almost invariably given for them (*see* page 470).

We subjoin some supplementary notes on the Leicesters and Border Leicesters. The Leicester breed may be said to have been founded by Bakewell, who began to improve the stocks of his native county

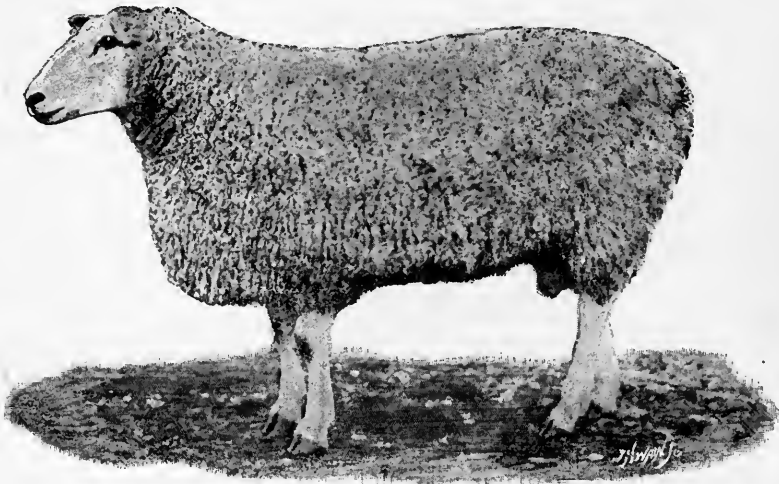


Fig. 110.—Border Leicester Shearling Ram.

The property of the Right Hon. A. J. Balfour, M.P., Whittinghame, Prestonkirk, N.B.

in 1755. The means that he employed were never accurately known. Some say he crossed the native Leicesters with Romney Marsh and Lincoln sheep. It seems more probable, however, that he adhered solely to the native sheep, and effected his great improvement through a long course of selection, combined with in-breeding as a means of fixing the type. Bakewell in fact was the author of that system of in-and-in-breeding which has been rather extensively practised since his time. His great object was to produce an animal with a marked aptitude to fatten, and with the least possible amount of offal, and he regarded wool as of secondary importance. His work of improving and developing the feeding qualities of the Leicester sheep was going on at the time when turnips first came to be cultivated as a field crop, and the introduction of the turnip crop gave a great impetus to the demand for early maturity. Bakewell died in 1795,

and his mantle fell on the brothers Matthew and George Cul'ey, two natives of Durham, who were great personal friends of his, and probably knew pretty well the secret of his methods. These brothers held the farm of Wark in Northumberland, and a great amount of land in the North of England; indeed it was said that the sum they annually paid as rent bulked up to the total of £6,000. After Bakewell's death the Leicester breed forked into two separate branches—the English Leicester and the Border Leicester—and these are now recognised as two distinct breeds by the National Agricultural Societies.

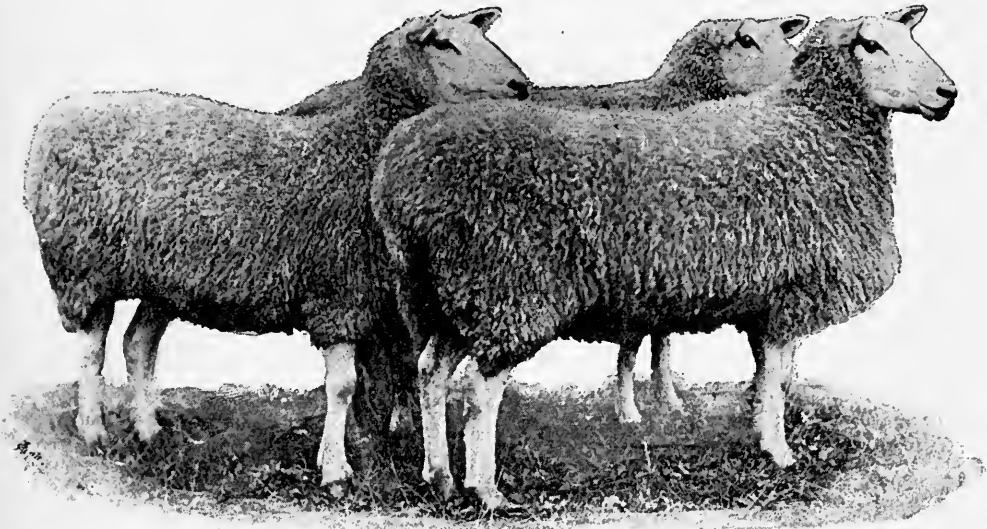


Fig. 111.—Border Leicester Ewes.

The property of the Right Hon. A. J. Balfour, M.P., Whittinghame, Prestonkirk, N.B.

The points of the typical Border Leicester may be set forth as follows: Sharp profile with dark full nostrils, black muzzle, and nose slightly aquiline, well-set ears, hair on the face and crown pure white, a blue crown being considered a serious fault; neck strong, with well-developed neck-vein, shoulders broad and full, ribs arched and round rather than deep, back broad and well laden with mutton of a muscular touch, rump and gigot full, belly well covered with wool, legs flat and clean, and wool fairly long with a nice *pirle*. The clip of a good flock will average 7 lb. per fleece. As mutton sheep the Leicesters are not in high repute, and as the ewes do not give very much milk they are not the best of nurses. But the Leicesters serve a most important use in producing a very superior class of butcher's sheep when mated with other breeds. Leicester rams are mated with black-faced ewes to produce grey-faced or "cross" lambs, with Cheviot ewes to produce half-

breeds, and with half-breeds to produce three-part-bred lambs, and the sheep obtained by this crossing are of splendid quality and of first-rate fattening properties.

The Border Leicester sheep of the present day have been mainly made what they are through the use of Mertoun blood, for there is hardly a flock of any consequence in the country which is not headed by sires that were either bred at Mertoun or are descended from Mertoun stock. The existing flock at Mertoun was founded by the present Lord Polwarth's grandfather in 1802, but Wright in his famous *Tour* in 1777 states that the Leicester sheep at Mertoun then were of quite as high a quality as the sheep owned by the brothers Culley at Wark. Lord Polwarth has followed Bakewell's system of in-breeding to an extent and with a success which is unequalled in the annals of stock-breeding, for not a single sheep born outside the flock was used in the flock for over thirty years. The flock, however, is divided into several different families, and these are carefully mated with each other, so that the sires and the dams shall be several degrees of consanguinity apart. Lord Polwarth has also made a point of watching how his best rams do when sold to head other flocks, and the best of these are often bought back after several years' use in such flocks. These rams, after living for a few years on different soil and in other environments, return practically as new animals to the old stock. The rams thus so closely bred are remarkably fine-boned stylish animals, and when put to out-bred stock they beget grand animals, and almost every prominent prize-winner at the present day is a direct descendant of some Mertoun-bred sire. The Mertoun rams never fail to fetch the highest price at the Kelso ram sales, where the best rams of the breed are sold. In 1890 the Mertoun draft of thirty shearlings realised the unprecedented average of £53 19s. 4d. The Messrs. Clark of Oldhamstocks founded their flock over thirty years ago, and at the Kelso ram sales their rams rarely fail to realise the highest average next to that of Lord Polwarth. Among more recently-established flocks, those of the late Lord Dalhousie, and of the Right Hon. A. J. Balfour, M.P., are very favourably known, on account of their high and genuine quality.

The old LINCOLN BREED closely resembled the old Leicester. They had white faces and legs, forward loose shoulders, a heavy head, with a large neck, and sinking dewlap; the bones large, and the carcass long and coarse; the back long and hollow, with flat ribs, but good loins, and a deep belly; the hind-quarter broad, and the legs standing widely apart. The pelt was particularly thick, and the fleece consisted of very long combing wool, of a rather coarse quality, weighing generally from 12 to 14 lb. on the wethers, and from 8 to 10 lb. on the ewes. The flesh was coarse-grained and inferior, but it frequently reached the weight of 35 lb. per quarter; and fat wethers generally averaged 25 lb. This description, however, applied to the old and now extinct breed of Lincolns. In the days of Bakewell and for a long time subsequently, there was much jealousy between the new Leicester

and the old Lincoln breeders, and the latter would have nothing to do with the former. Eventually, however, this feeling died out, and by a



Fig. 112.—Lincoln Ram.

Champion at the Royal Agricultural Society's Show at Birmingham, 1898.  
Bred by Mr. Henry Dudding, Riby Grove, Stallingboro', Lincolnshire.



Fig. 113.—Pen of Lincoln Ewes.

Winners of the Champion Prize at the Royal Agricultural Society's Show at Lincoln, 1907. The property of Mr. C. E. Howard, Nocton Rise, Lincoln.

judicious use of Dishley blood, and by careful selection, the Lincolns were immensely improved, and, while they still retain the valuable

properties, so essential on rich soils, of great weight of fleece and carcass, they have acquired some of the distinguishing marks of the Leicester, in the increased cleanness of the head, straightness of the back, and general symmetry.

The main differences between Leicesters and Lincolns are seen in the larger and bolder heads of the latter. The wool of the Lincoln grows in large and bold masses, and is denser, longer, and heavier than that of the Leicester. The Lincoln fleece averages from 8 to 9 lb. The face of the Lincoln is uniformly white, whereas dark or black spots are often to be seen on the ears and faces of the Leicester. The Lincolns are more popular now than the Leicesters, even at home;



*Photo by*

**Fig. 114.**—Wensleydale Ram.

*G. H. Parsons.*

First in the Shearling Class at the Royal Agricultural Society's Show at Lincoln, 1907. The property of the Executors of the late Mr. Thomas Willis, Carperby, Yorks.

while, for crossing with other breeds in Australia and Argentina, they are in very high favour. (*See* figs. 112 and 113.)

THE WENSLEYDALE longwools (fig. 114) are the lineal descendants of the old Teeswater breed, which were formerly the stock of the northern part of the Vale of York and of Cleveland. They underwent a great change by crosses with Leicester rams and their descendants, which were introduced into the North by Messrs. Culley, about the year 1766; the Teeswater itself was really a variety of the Leicester.

In their unimproved state they were rather taller than some of the long-woolled breeds, and had a peculiarly clumsy appearance; but they were smaller in the bone, and yielded a heavier carcass, and finer-grained meat than their general appearance would suggest. The ewes were very productive, twins being common, and triplets occasional.



The Wensleydale breeders formed an association in May, 1890, and established a Flock-Book, the first volume of which states that the characters in favour of the Wensleydales are, that they are good breeders, excellent mothers, good feeders, have a nice leg of mutton, and a class of wool that makes a price equal to any Leicester. The Flock-Book also states that the points approved by the Association are as follows:—*Head*,—Face dark, ears dark and well set on, head broad and flat between ears, muzzle strong in rams, a tuft of wool on forehead, eyes bright and full, head carried gaily; *neck*,—moderate length, strong and well set on to the shoulders; *shoulder*,—broad and oblique; *chest*,—deep and wide; *wool*,—bright lustre, curled all over body, all alike in staple; *back and loins*,—ribs well sprung and deep, loin broad and



Fig. 115.—Kent (or Romney Marsh) Ram.

First in the Shearling Class at the Royal Agricultural Society's Show at Lincoln, 1907.  
The property of Mr. C. File, Elham, Canterbury.

covered with meat, tail broad, flank full; *legs and feet*,—straight, and a little fine wool below the hock, fore legs well set apart, hind-legs well filled with mutton; *skin*,—blue, fine, and soft.

Certain other Wensleydale breeders have formed a second association for the promotion of the interests of what they claim to be the only "pure" breed. Their Flock-Book, which they started in September, 1890, is restricted to the descendants of what used to be called the "Mugs."

THE ROMNEY MARSH OR KENTISH SHEEP (fig. 115) have existed immemorially on that rich tract of grazing land on the southern coast of the county of Kent, from which they take their name. In

their original state they were distinguished by white faces, a considerable thickness and length of head, and a broad forehead with a tuft of wool upon it, a long and thin neck, and flat-sided carcass. With wide loin there were a narrow breast, thick legs, coarse muscle, and large bone. The wool was of a good quality, and the fleece of fattening wethers weighed from 8 to 9 lb. They were hardy, bred with little care on wet and exposed land, requiring after the first year, when they were wintered on the uplands, no other food, in the most exposed situations, than occasionally a little hay in addition to their pasture, and were fattened entirely on grass.



Photo by

Fig. 116.—Devon Longwool Ram.

G. H. Parsons.

First in the Shearling Class at the Royal Agricultural Society's Show at Lincoln, 1907.  
The property of Mr. F. White, Torweston, Somerset.

On this breed the ameliorating influence of the Leicester in the early part of the century, combined with a general awakening of the breeders to the need for greater care in managing their flocks and selecting their rams, had a marked effect. The result was to reduce the size of the animals, and make the wool lighter and closer, while, however, it gave them a better disposition to fatten.

THE DEVON LONGWOOL (fig. 116) is another breed which owes much to the "Leicester wave." The original stock were the Bampton Notts,<sup>1</sup> which have existed in the district surrounding Bampton from time immemorial. In 1808 they were described as "a profitable class of sheep, which at twenty months old weighed 22 lb. per quarter, and sheared 6½ lb. of wool to the fleece." The owners of this breed very

<sup>1</sup> "Nott" signifies "Polled."

wisely availed themselves to a considerable extent of the Leicester cross, and a report on the farming of Somerset, published in 1850, stated that it was then considered that "there could not be a better sheep for the purpose of the farmers of the rich lands than the improved Bampton crossed with Leicester." Many breeders so far introduced the Leicester blood that their flocks might eventually have been described as three-quarters Leicester, and one-quarter Bampton. For many years now the breed thus resulting has been kept pure, and has assumed the name of Devon Longwools. An association for the promotion of the interests of the breed and the establishment of a Flock-Book was started in 1889.

THE SOUTH DEVON or SOUTH HAMS sheep are another local Devonian variety which was transformed by the Leicester invasion, but which retains its original name. The origin of the South Hams Notts is somewhat uncertain. Their home seems to have been in the Vale of Honiton, though now in their improved form they have spread along the South of Devon and into Cornwall. They are described as having been an inferior description of sheep and ill-shaped, carrying heavy but coarse fleeces, and coming to a great weight. They had brown faces and legs, thus indicating an affinity with the Down. By crossing with the Leicesters this naturally coarse-fleshed sheep was improved in quality, so that they fatten earlier, and a finer and more silky fleece is obtained. The wool is moderately fine, and the staple long; the fleece weighs about 9 lb. At the Plymouth Show of the Royal Agricultural Society, 1890, there was a small but excellent display of this breed, which proved that the South Hams had developed into a very useful class of sheep.

THE COTSWOLDS are another variety of long-wooled sheep which are found chiefly on the Gloucestershire hills from whence they take their name. They have lived there from time immemorial, and from the earliest periods of English history have been celebrated for length of fleece, and for hardiness of constitution. They are unquestionably well adapted to the Cotswold soil and climate. They, too, were crossed with the Leicesters, and were considerably improved thereby, the "new Cotswold"—as one writer says—"having a decided advantage over the old, on account of the greater hardihood as compared with the pure Leicester, and the deeper grown nature of the wool than in the original stock."

The general characteristics of the Cotswolds (fig. 117) are their bold and commanding appearance, their finely arched neck giving them an ease of carriage when walking which is peculiarly their own. They have broad straight backs with arched ribs and length of quarter, carrying an enormous weight of carcass upon clean yet open legs. Their shoulders are rather open, but in line with the back, thus giving them a good appearance in the sheep pen; the chest is broad and deep. They have great thickness through the heart; at a show some years ago two of the winning two-shear rams girthed 5 feet and 5 feet 4 inches

respectively. The reporter on the sheep at the Royal Agricultural Society's Show in 1889, remarks, "The Cotswold ram, as one saw him at Windsor, is of all south-country sheep most deserving the epithet 'grand.' His rakish-looking 'love-lock,' well-carried head, long, broad back, well-sprung ribs and long curly coat give him a very attractive aspect." The wool, when washed, is of good colour, and averages from 6 to 8 inches in length, and the fleece weighs from 7 to 8 lb. Of late years the Cotswolds have been greatly in demand for exportation. Some time since certain breeders endeavoured to establish a grey-faced

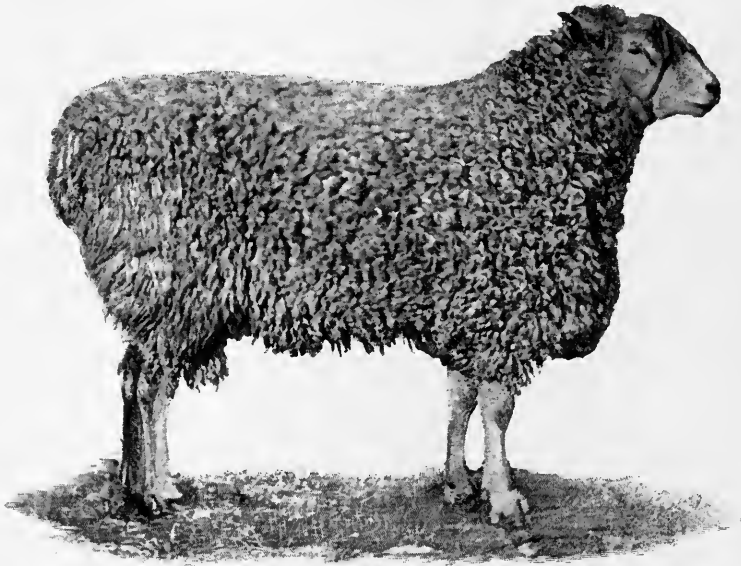


Fig. 117.—Two Shear Cotswold Ram, with two months' growth of wool.

The property of Mr. Russell Swanwick, Royal Agricultural College Farm, Cirencester.

variety, under the name of "Cotswold greys," but we believe only one or two flocks now remain, and the movement may be said to have died out.

We now come to the *short-woolled* breeds.

THE SOUTHDOWN SHEEP (fig. 118)—according to Mr. Ellman, who was one of the best judges, as well as a most extensive breeder, of them—should have the head small and hornless, the face speckled or grey,<sup>1</sup> the under jaw fine and thin, and the whole space between the ears well protected with wool; the eye full and bright; the neck thin towards the head, but enlarging towards the shoulders, and there broad and high; the chest wide, deep, and projecting between the fore-legs; the shoulders level with the back, bowing outwards from the top to the breast,

<sup>1</sup> A light brown, or brown grey, is now the generally accepted colour.

leaving room for a springing rib beneath; the ribs coming out horizontally from the spine, and the last rib projecting more than the rest; the back flat from the shoulders to the tail; the loin broad and flat; the hips wide; the belly as straight as the back; the legs neither too long nor too short, fine without weakness, and of a speckled or dark colour; the belly well covered with wool, the wool coming down before and behind to the knee, and short, close, curled, fine, and free from spiry projecting fibres; the flesh fine-grained, and of excellent flavour. Fat wethers used to average about 18 lb. per quarter; but this has been



*Photo by*

*G. H. Parsons.*

**Fig. 118.—Southdown Ram.**

Champion at the Royal Agricultural Society's Show at Lincoln, 1907.  
The property of Mr. W. M. Cazalet, Fairlawn, Tonbridge.

considerably increased by late attempts to improve the size of the carcass.

The sheep have been bred for ages past on the chalky soils of the South Downs in Sussex, and, on such short pasture and exposed situations, they are perhaps the most valuable breed in the kingdom. They were materially improved, nay, brought to their present perfection, by John Ellman, of Glynde, at the latter end of the last century, and extended all over the country, their influence on the short-wool breeds being very similar to that exerted by the Leicesters on the long wools. In consequence of this extension and the fact that they became established in diverse situations and on various soils, there was a natural tendency to a difference of type, and some twenty years ago there was considerable discussion between breeders on this point. Of late years,

however, breeders have realised that where a breed is kept over a wide area, the rigid uniformity of model which was possible when it was confined to a few adjacent parishes, so to speak, is not to be looked for. The precise effect of soil and climate on the development of sheep is a matter which science may in the future be able to define and explain, but at present we can only note that the modifications—especially of the fleece—which result from varying farming conditions are as obvious as they appear to be inevitable.

THE HAMPSHIRE DOWN is a development, within the present century, from the old Wiltshire horned sheep (fig. 119) and the Berkshire Nott or Knot—two indigenous breeds which ranged the Downs of Wiltshire,

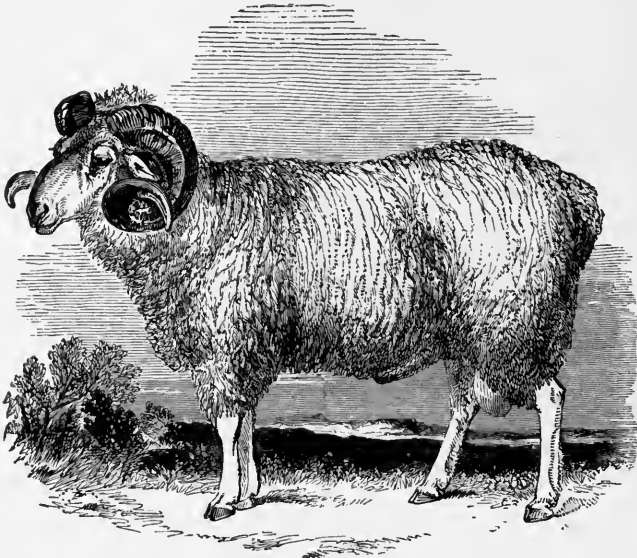


Fig. 119.—The Old Wiltshire Horned Sheep.

Hampshire, and Berkshire probably for centuries—by judicious crossing with the improved Southdown. The Wiltshire breed were distinguished by large spiral horns bending downwards, close to the head. They were perfectly white in their faces and legs; had long Roman noses, with large open nostrils; were wide and heavy in their hind-quarters, and light in the fore-quarter and offal. The quality of the fleece was that of clothing wool of moderate fineness, averaging nearly 3 lb. in weight; and the carcasses of the wethers, when fat, usually weighed from 70 to 90 lb.

The following particulars of the present breed are taken from the introduction, written by Messrs. E. P. Squarey and J. E. Rawlence, to the first volume of the Hampshire Down Flock Book, published in 1890:—

“Almost concurrent with the commencement of the enclosure of the

common lands, about eighty years since, large areas of the Down lands, which had served as admirable feeding grounds for the South Downs, were broken up. A little later artificial manures were introduced. These conditions induced the farmers to largely increase the growth of artificial crops, such as turnips, rape, vetches, trifolium, rye and Italian rye-grass, for sheep-feed.

"The consumption of these artificial crops by sheep led breeders generally to turn their attention to the system adopted by the Hampshire men of selling their wether lambs, in the late summer or early autumn, instead of keeping them, as was then the custom, until they became two-teeth, or four-teeth sheep, when they were sold at a smaller



Photo by

G. H. Parsons.

Fig. 120.—Hampshire Down Shearling Ram.

First at the Royal Agricultural Society's Show at Lincoln, 1907.  
The property of Mr. J. Flower, Chilmark, Salisbury.

price than the lambs now realise. Under these conditions it was important to secure early maturity and greater size, and the flock-masters, with very few exceptions, at once crossed with the Hampshire Downs, and now successfully compete at all the early fairs with their Hampshire brethren.

"It is now generally allowed that no breed of sheep attains such early maturity as the Hampshire Down lambs in the month of March and April, as they attain a dead weight of from 12 to 14 lb. per quarter, and realise from 50s. to 55s. per head, and by the month of October (that is, at an age of 9 months) weigh as much as 80 to 100 lb. of mutton, and in some seasons realise as much as 75s. per head, whilst the ram lambs, which are sold for service during the months of July and August (at which age the sires of this breed are generally worked) often reach a dead weight of 120 lb., and command, at the auctions of the season,

from 100 guineas downwards, thus proving the enormous advantages, in the way of quick returns, enjoyed by the Hampshire Downs over many other breeds.

“The chief points of a true-bred Hampshire Down sheep (fig. 120) are:—A long, deep, and symmetrical carcass, with the ribs well sprung, broad straight back, flat loins, full dock, wide rump, deep and heavily developed legs of mutton and breast, head and neck well placed on gradually sloping and closely fitting shoulders, the neck being particularly of a strong muscular growth and not too long, the ears nicely set on, of fair length and whole coloured; prominent intelligent eye; the body, as above described, standing on strongly jointed and power-



*Photo by*

**Fig. 121.—Oxford Down Ram.**

*J. T. Newman.*

First in the Shearing Class at the Royal Agricultural Society's Show at Lincoln, 1907.  
The property of Mr. James T. Hobbs, Maisey Hampton, Fairford.

ful legs, with good feet, presenting a smart and attractive appearance. The colour of the face, cheeks, ears, and legs should be of a rich dark brown, approaching to black, white specks or black bar between the ears being especially avoided. The wool is moderate in length, of close and fine texture, reaching well over the forehead, the skin being of a delicate pink.”

THE OXFORD DOWN originated in the deliberate crossing of two distinct types of sheep, the long-wool and the short-wool. As it has on the whole approximated more to the Down character—while largely retaining the weight of fleece and size of the long-wool—it is now usually classified with the Southdowns and Hampshire Downs. Its



history is practically contemporaneous with the Victorian era, for it was during the reign of William IV. that the idea occurred almost simultaneously to a few distinguished sheep breeders of that day to establish the new breed. Since that time its success has been remarkable. An association was started in 1888, and the first volume of the Flock Book appeared in the following year. In the introduction thereto, the secretary—Mr. R. Henry Rew—observes that “Oxford Downs are now found in districts so widely separated—ranging from



*Photo by*

*J. T. Newman.*

**Fig. 122.—Oxford Down Ewe Lambs.**

First at the Royal Agricultural Society's Show at Lincoln, 1907.  
The property of Mr. Hugh W. Stilgoe, Addisbury, Banbury.

Cornwall to Scotland and from Wales to Norfolk—that it must obviously be a work of some little time to bring all those who are interested in the breed into touch with the association.” The following particulars are condensed from the introductions to the first and second volumes of the Flock Book :—

For a long time after its establishment the new breed went by various names. That most in vogue for some years was the term “Down Cotswolds.” It was about the year 1857, at a meeting of breeders held in Oxford, that the title of “Oxfordshire Downs”—now for the sake of convenience shortened to Oxford Downs—was adopted. There was a slight difference in the original cross, Mr. Druce using South-downs and Cotswolds, and Mr. Twynam Hampshires and Cotswolds,

As a matter of fact Southdowns of the coarser type were used certainly by Messrs. Druce and W. Gillett, and probably by most of those who followed their example.

Mr. Clare Sewell Read, in his report on the "Farming of Oxfordshire," published in the *Journal of the Royal Agricultural Society* in 1854, refers to the Oxford Downs as "the glory of the county—the most profitable sheep to the producer, the butcher, and the consumer."

The extension of the popularity of Oxford Downs is indicated by the entries in the second volume. The 65 flocks separately entered—as against 54 in Volume I.—represent at least fifteen English counties, as well as Scotland and Wales. The breed is now largely kept in Norfolk, where it seems to be rapidly taking the place of the old half-breds of the district, and it finds a home in increasing numbers in Cornwall. Oxford Downs flourish alike in the warm counties of the South and West and on the bleak hills of Aberdeenshire. In fact they adapt themselves to all climates and circumstances. The rams are in great demand for Germany, where no other breed answers so well for crossing with the Merinos. Their popularity yearly increases in the United States, while rams have also been sent to Buenos Ayres and Brazil, as well as to Australia and New Zealand.

Oxford Downs may fairly be called the "general purpose" sheep. At any rate they are very accommodating. They can be sold as fat lambs at from 5 to 8 stones, or as fat tegs at from 10 to 12 stones. In short, if they are kept well from birth, they can be sold at any weight which suits the market; but at Islington the butchers buy most freely those which do not exceed 9 stones. For early maturity, leanness of meat, fine and heavy fleeces, hardness of constitution, and good grazing propensities, their merits are undeniable.

A good Oxford Down ram (fig. 121) may be described broadly as follows:—He has a bold masculine head, well set on a strong neck; the poll is well covered with wool and adorned by a top-knot; the ears are self-coloured and of good length; the face is a uniform dark-brown colour; the legs are short, dark-coloured (not spotted), and placed well outside him; the barrel is deep, thick, and long, with straight underline; the chest wide; the back level; ribs well sprung; tail broad and well set on; the mutton is firm, lean, and of excellent quality; the fleece is heavy and thick on the skin.

In fig. 122 we give an illustration of a group of Oxford Down ewe lambs bred by Mr. Hugh W. Stilgoe, of Addisbury, Banbury, which won the first prize at the Royal Agricultural Society's Show at Lincoln in 1907.

THE SHROPSHIRE breed (figs. 123 and 124) resembles, in many of its characteristics, the Southdown, although in fleece and in carcass it is heavier, and in constitution more robust.

In some of the counties bordering on Herefordshire, both in England and Wales, there was a breed of sheep very much resembling the Ryelands, and known as the Shropshire Morfe. They carried wool of

a fine quality, and generally had white faces and legs, although sometimes a little freckled. They were light in the bone, and had small clean limbs.

In the third volume of the Shropshire Flock-Book, Mr. A. Mansell wrote an introduction, from which the following particulars are mainly taken. The Shropshire sheep is descended from a breed which has been known to exist in Shropshire and Staffordshire for upwards of a century, for Plymley, writing on the agriculture of Shropshire in 1803, thus describes the sheep:—"There is a breed of sheep on the Longmynd with horns and black faces that seems an indigenous sort. They are nimble, hardy, and weigh nearly 10 lb. per quarter when fattened. The fleeces, upon the average, may yield 2½lb."



*Photo by*

**Fig. 123.—Shropshire Ram.**

*G. H. Parsons.*

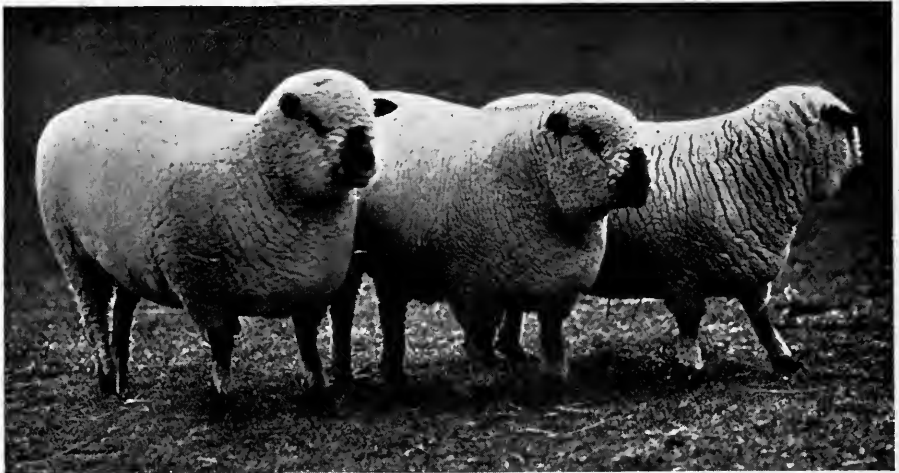
First in the Shearling Class at the Royal Agricultural Society's Show at Lincoln, 1907. The property of Mr. Matthew Williams, Whiston Hall, nr. Wolverhampton.

The recognition of the breed in the Royal Agricultural Society's showyard, at Gloucester in 1853, was the turning point with the Shropshire sheep, and encouraged breeders to use their best judgment in selection and do all in their power to place their breed of sheep in the front rank.

Many years ago much used to be written respecting a want of uniformity of character and type amongst Shropshires, but now breeders may fairly be congratulated upon having established the character of the breed and the particular type to be aimed at, as well as the breeders of any other sheep.

In describing "what a Shropshire sheep should be," Mr. Mansell says, "I cannot do better than give the points which influenced the

three eminent men, viz., the late Mr. R. H. Masfen, Mr. John Evans, and Mr. Henry Lowe, who acted as judges at the Birmingham meeting of the Royal Agricultural Society in awarding the prizes at that Show. They say, in their report in the Royal 'Journal,' that they selected for prizes those animals which they considered best calculated to uphold and perpetuate the most distinctive type of the Shropshire, viz., a well-developed head, with clear and striking expression of countenance, a muscular neck well set on good shoulders, the body symmetrical and deep, placed as squarely as possible on short legs, due regard being paid to grandeur of style, a well-covered head, and wool of the best staple and most valuable kind, rejecting as much as possible all animals



*Photo by*

**Fig. 124.—Shropshire Shearling Ewes.**

*G. H. Parsons.*

First at the Royal Agricultural Society's Show at Lincoln, 1907.  
The property of Sir R. Cooper, Berkhamsted.

showing an inclination to produce black wool or dark skins. I may add as a rider to this description that the skin should be a nice cherry colour, and the face and legs a nice soft black, not sooty, nor rusty brown, and free from all white specks. The belly also should be well-woolled, and all inclination for the wool to peel at the jaw and legs should be avoided. These are minor points but, to assure success in the showyard, or remunerative results in the sale ring, they must not be lost sight of."

THE CLUN FOREST sheep (fig. 125) takes its name from a district occupying the south-west corner of Shropshire, which has Radnorshire on the south and Montgomeryshire on the west. It is a composite breed, in the moulding of which the Ryeland, the Shropshire, and the Welsh breeds have all taken part. Fixity of type has not yet been attained, some breeders advocating a black face, others a mottled face,

while many prefer the tan or fawn-coloured face with an occasional white spot. The development of the original native Forest sheep to the present type has extended over a lengthened period, and but little accurate record has been preserved of the changes which have taken place.

“Granted the breed is a little unformed, or perhaps does not show the effect of the skill of the breed-maker, as do some of the older-established breeds, yet there is undoubtedly in it those characteristics which can be moulded by skilful hands into a sheep which would be hard to beat. The excellence of the meat and wool cannot be denied ;



Fig. 125.—Clun Forest Ram.

The property of Capt. Campbell-Hyslop, Church Stretton, Salop.  
(From a photograph taken in the month of March).

while the shapely well-covered head, with slightly Roman nose, the bold scrag, and the free imperious step denote a robustness with which the breeder may take liberties in order to produce a more rapid maturity, without being afraid of rendering it effeminate or weakly. The horns are being bred out.”<sup>1</sup>

THE RYELAND sheep (fig. 126) has been preserved from a remote period in Herefordshire, and at one time was very widely kept. It has

<sup>1</sup> See “Clun Forest Sheep,” by W. J. Malden. *Journal of the Royal Agricultural Society*, Vol. III., 3rd series, 1892, pp. 149 to 155.

now been, as a rule, succeeded by the Shropshire, and the number of pure-bred Ryeland flocks is probably very limited. These sheep are small and hornless, and distinguished for the great fineness of their wool, which is superior for carding purposes to that of any other English breed. The introduction of fine foreign wool no doubt had much to do with the diminution of this breed in popularity.

THE SOMERSET and DORSET HORNED breed (fig. 127) is one of the oldest in the kingdom, and has been preserved practically pure, though the sheep have been greatly improved in size, shape, and fleece during the past fifty years. The ram has a singularly long convoluted horn,

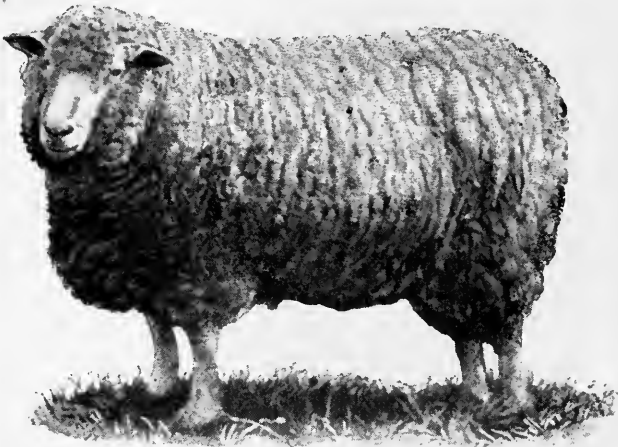


Fig. 126.—Ryeland Ram in Full Wool.

The property of Mr. Frank Shepherd, The Brook, Colwall, Malvern, Worcestershire.

this outgrowth being less developed in the ewe. The muzzle, legs, and hoofs are white; the nostrils are pink. The chest is deep, and the loins broad. The wool is of an intermediate kind between long and short, and of medium fineness, weighing about 4 lb. per fleece; and the carcass averages 18 lb. per quarter of excellent mutton.

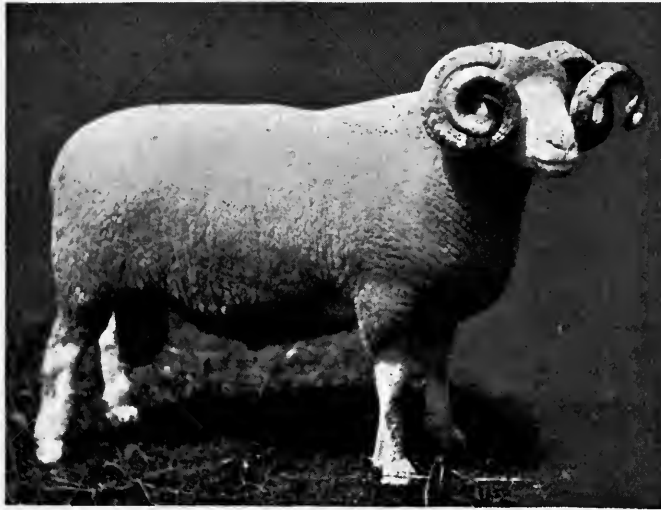
The Dorset Horns are a hardy race, being chiefly bred on open downs, and inured to the fold; but their principal value consists in the peculiar forwardness of the ewes, which take the ram at an earlier period than any other breed, and are therefore much sought after, and command high prices, for the purpose of producing early lamb for winter consumption. They will take the ram as early as April.

At one time this breed occupied the greater part of the chalk district, but they had to give way before the Southdowns and Hampshire Downs, which were more suited to the situation. The principal flocks are found in the neighbourhood of Dorchester, but latterly they have extended their range, flocks now existing in many parts

of the kingdom. The breed is famous for fecundity, and the ewes for excellent nursing, and for taking the ram at the desired period of the year for enabling them to produce very early lambs.

The interests of the breed are looked after by the Dorset Horn Sheep-breeders' Association, which was constituted in 1891.

THE SUFFOLK breed (fig. 128) has of late years risen into considerable repute in its own county, and to some extent in the adjoining counties of Cambridge and Essex. The establishment of a Flock-Book and



*Photo by*

*G. H. Parsons.*

**Fig. 127.**—Dorset Horned Ram.

First at the Royal Agricultural Society's Show, 1907.  
The property of Mr. E. A. Hambro, Hayes Place, Kent.

the admission of the breed to the distinction of separate classes at the Shows of the Royal Agricultural Society of England have done much to bring the sheep into general notice.

Early in the present century, according to Mr. Ernest Prentice in the Suffolk Flock-Book, a breed of Suffolk sheep existed which had been founded by crossing the original horned Norfolk ewes with improved Southdown rams.

The mingling of the form and fattening properties of the Southdown with the hardy Norfolk resulted in a valuable type of animal. In the progeny the purer blood of the Norfolks asserted itself in the characteristic black faces and legs; and the objectionable feature—the horns—was eliminated by selection in the course of a few years.

It was in 1859 that the name of "Suffolks" was first given to these Southdown-Norfolks. The characteristics of the sheep may be gathered from the following list of points drawn up by the Suffolk Sheep Society:—

*Head*,—Hornless: Face black and long, and muzzle moderately fine—especially in ewes. (A small quantity of clean white wool on the forehead not objected to.) Ears, a medium length, black and fine texture. Eyes, bright and full. *Neck*.—Moderate length and well set. (In rams strongly, with a good crest.) *Shoulder*.—Broad and oblique. *Chest*.—Deep and wide. *Back and Loin*.—Long, level, and well covered with meat and muscle; tail broad and well set up. The ribs long and well sprung, with a full flank. *Legs and Feet*.—Straight and black, with fine and flat bone. Woolled to knees and hocks, clean below. Fore-legs set well apart. Hind-legs well filled with mutton. *Belly*.—Well covered with wool. (Also scrotum of rams.) *Fleece*.—

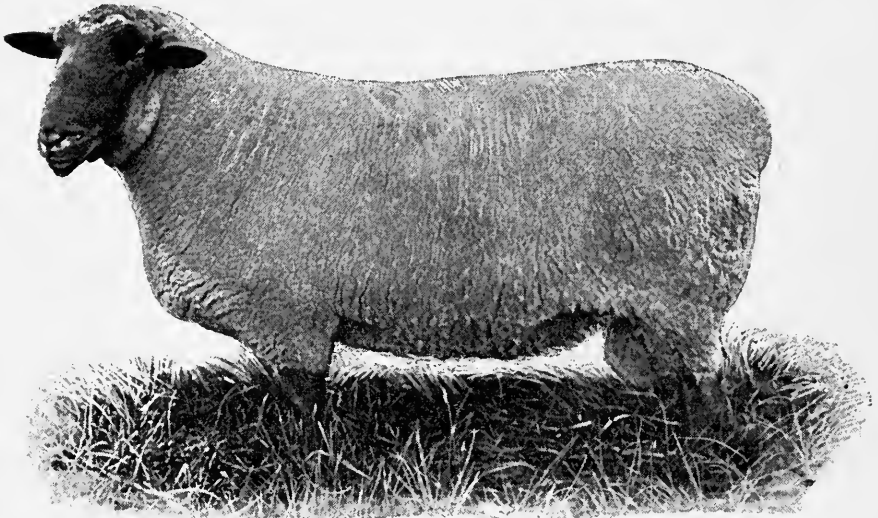


Fig. 128.—Suffolk Ram, "Sailor Prince."

Winner of the Champion Prize given by the Suffolk Sheep Society for the best Suffolk Ram at the Jubilee Show of the Royal Agricultural Society of England, Windsor, 1889. Bred and exhibited by Mr. Edward Gittus, of Snailwell, Newmarket, Cambridgeshire.

Moderately short; close, fine, lustrous fibre, without tendency to mat or felt together, and well defined, *i.e.*, not shading off into dark wool or hair. *Skin*.—Fine, soft, and pink in colour.

Reference has now been made in the preceding pages to all the recognised breeds of sheep which are practically known to British farmers at the present time. It may, however, be desirable to mention one or two other varieties which have an interest, even though it be of rather limited extent.

THE SHETLAND breed derive their name from the islands off the northern coast of Scotland, where they are reared. The wool is fine and soft, and suited for the most delicate manufactures. The fleece usually weighs from 1 to 3 lb. The Shetland sheep are very hardy.



Within recent years they have been imported in large numbers into the mainland of Scotland, where they are fattened and yield excellent mutton.

The ISLE OF MAN possesses a breed that bear much resemblance to the Welsh sheep. Some of them are horned, and others polled. Their general colour is white, but many are grey, and a few are of a peculiar brown colour, provincially termed *Laughton*. This is the distinctive mark of the breed. A Laughton-coloured patch is found on the back of the neck, or it occasionally spreads over the whole of the animal.



Fig. 129.—Merino Ram.

(At 7 years old, clipped 12 lb. of long fine white wool.)

Imported from Otago, New Zealand, in 1887, by Mr. L. A. Macpherson, Wyrley Grove, Pelsall, Staffs.

In Ireland the chief native breed is the ROSCOMMON, which has been greatly improved within the past twenty-five or thirty years by the introduction of Leicester blood, and by careful selection. There was a limited but good display of these sheep at the Windsor Show of the Royal Agricultural Society in 1889.

THE MERINO, in spite of its supremacy in Europe, as well as in America and Australia, has entirely failed to establish a footing in Britain.

These sheep (fig. 129) have horns somewhat large in size, curved or spiral, the ewes, however, being generally hornless. The faces are white; the legs of the same colour, and rather long; a portion of loose skin depending from the neck; the bone is fine, and the pelt fine and clear. The wool is exceedingly fine, and weighs, upon an average,

3½ lb. per fleece. In 1792 George III. imported several rams of the Negretti breed, and a determined attempt was made under the most distinguished auspices to introduce Merinos for the purpose of improving the sheep of the country. The experiment was for a time fully and satisfactorily worked out. Flocks of the pure Merino were kept by several public-spirited individuals, and the wool which they produced was equal to any that could be imported from Spain. Various breeds of British sheep were crossed with the Merinos, and the result generally was that, to a great extent, the wool was increased in length and weight and fineness, but the carcass diminished, or at any rate was not improved. Even in Australia, New Zealand, and the Argentine Republic, since the export trade in frozen mutton and lamb was started, the Merino has given place to a great extent to British breeds and crosses.

Did the farmer look to the fleece as his only or his chief source of remuneration, the Merino breed, or rather judicious crosses from it, would gradually supersede every other; but no breed can ever be adopted in this country—however it may increase the value of the wool—which is deficient, as the Merinos undeniably are, in the properties of early maturity and general propensity to fatten.

It is of interest to record that at the Show of the Royal Agricultural Society, held at Newcastle in 1908, the following sections were arranged for sheep, in the order indicated:—Oxford Down, Shropshire, South-down, Hampshire Down, Suffolk, Dorset Horn, Ryeland, Kerry Hill, Lincoln, Leicester, Border Leicester, Cotswold, Kent or Romney Marsh, Wensleydale, South Devon, Cheviot, Lonk, Herdwick, Welsh Mountain, and Black-faced Mountain.

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## CHAPTER II.

### ON THE BREEDING AND MANAGEMENT OF SHEEP.

**B**EFORE we proceed to discuss this branch of rural economy, it will be necessary to state the names or terms by which sheep are generally known at different ages; though these vary somewhat in the counties of Britain.

From the time of weaning to the first shearing the entire males are denominated ram lambs, hogs, hoggets, or hoggerels; after which they receive the appellation of shearing, shearling, or diamond tups, or rams. They are then called two, three, or four shear, according to the number

of times they have been shorn; or "two-teeth," "four-teeth," "six-teeth," or "full-mouthed" rams, as indicated by their teeth (*see* pages 415—16).

When male sheep have been castrated, they are termed—from the period of weaning to that of shearing—wether, or wedder or shear hogs or tegs, then shearings, shearlings, dinmons, &c.; or they are after the first shearing denominated two-teeth, then three or four-teeth wethers, and finally, full-mouthed.

The females from the time of weaning to the first shearing are termed ewe or gimmer-hogs or tegs; they then take the name of shearing ewes, gimmers or theaves, which continues only for one year, after which they are denominated twinters and thunters, viz., two and three-shear, or four-shear ewes, or are named, in the same way as male sheep, according to their teeth; subsequently they become old ewes or crones.

Breeds like the Hampshire Down, which are fed well all their lives, renew their first two teeth at from 12 to 16 months, and sometimes sooner, but the subsequent pairs come at intervals of less than a year between each pair, and the sheep are generally full-mouthed at  $3\frac{1}{2}$  years. At the second shearing there are 4 teeth up, and at the third shearing 6 have been up for some little time; in a few months afterwards the mouth is "full."

With respect to the selection of sheep, as an item of *live stock*, the same principle of symmetry of form, and other requisites belonging to a good breed of cattle, such as have already been specified, are equally applicable. The breeder, or grazier, should examine the nature of his land; and, having attentively weighed its relative degree of fertility, and his various sources for supplying food, he may proceed to purchase that breed which, after mature consideration, he has reason to believe is best adapted to his circumstances. On this point the introductory view of breeds and varieties, already given, will probably afford some guidance.

We proceed, however, to state some particular points that will demand the breeder's attention; and, as in all cases the male has the greater influence, we begin by specifying the requisites that are essential to a good *ram*.

"His head should be well formed and masculine; his nostrils wide and expanded; his eyes prominent, and rather bold and daring; his ears thin; his collar full from his breast and shoulders, but tapering gradually all the way to the junction of the neck and head, which should be fine and graceful, being perfectly free from any coarse leather hanging down. The shoulders should be broad and full, and must at the same time join so freely to the collar forward and chine backward, as not to leave the least hollow in either place. The mutton upon his arm, or fore-thigh, must come quite to the knee; his legs should be upright with a clean fine bone, equally free from superfluous skin and coarse hairy wool, from the knee and hough downwards. The breast broad and well forward, which will keep his fore-legs at a proper width from each other. His girth, or chest, should be full and deep, and, instead of a hollow behind the shoulders, that part, by

some called the fore-flank, should be quite full; the back and loins broad, flat, and straight, from which the ribs must rise with a fine circular arch. The belly should be straight; the quarters long and full, with the mutton quite down to the hough, which should stand neither in nor out; his *twist* (*i.e.*, the junction of the inside of the thighs) deep, wide, and full, which, with the broad breast, will keep all his legs open and upright; the whole body covered with a thin pelt; and that with fine, bright, soft wool."<sup>1</sup>

Such was the description of the animal recommended by Mr. Culley, who observed that the nearer any breed of sheep comes to it, the nearer it approaches to excellence of form; and in the main his description is generally applicable now.

It should, however, be remembered, that symmetry consists in that shape which is best suited to the soil on which the animal is bred, so that what would be thought perfect in a Leicester sheep may be found a deformity or an objection in a Southdown or a Cheviot.

The *pelt*, or coat, should always be attentively examined, in order to ascertain whether it is not *stitchy-haired*; for in this case the fleece would be so materially damaged, in the course of two years, that the injury would not be remedied for a long period, or unless the whole flock was changed.

The fineness of wool is not the only criterion by which it should be estimated, even in the short-wooled breeds; the *staple* is also of great importance.

Ewes will generally breed at the age of a year, but even in times when there has been a special demand for lambs, it has rarely been found profitable to allow the ewes to take the ram sufficiently early for this, as the risk of loss is too great. As a rule, ewes lamb for the first time when two years old, the ram having been put to them when they were at the age of 1 year and 7 months. As to the precise time, however, at which the ram is admitted to the ewes, much depends on the goodness of the food, as well as the forward or backward state of the breed. The choice of ewes should be determined with care and discrimination, not only as to the characteristic marks, which should be the same as those of the ram, but also with regard to the breed; with sheep, as with other stock, the highest degree of excellence can be obtained *when the female possesses an equal degree of blood with the male*.

The purchaser should particularly ascertain that the sheep are *sound*; and, as an assurance of this, the teeth should be white, the gums red, the breath not fœtid, the eyes lively, the wool firm, and the feet cool.

Ewes bring forth one, two, and sometimes three lambs,<sup>2</sup> after a period of gestation of twenty-one or twenty-two weeks: hence the sheep-farmer or breeder may, by considering whether he has sufficient grass to support

<sup>1</sup> Culley on Live Stock, pp. 103, 104.

<sup>2</sup> According to M. Teissier's experiments on gestation (already alluded to), out of 912 ewes, 140 lambed between the 146th and 150th day; mean time 148 days.

576 " " 150th and 154th day; " 152 "

96 " " 154th and 161st day; " 157½ "

Giving a mean of 152 days.

the ewes and their progeny in the spring, ascertain the most advantageous period for lambing.

The usual time of weaning is regulated to a great extent by the period at which suitable food can be obtained for the ewes and lambs. Where the sheep are to be kept entirely on grass it is useless to get lambs at Christmas as they would be starved, therefore March and April are the usual months for lambing on good pastures in low-lying districts, and it continues through May in cold upland districts. About April 20th is the normal date at which the lambing begins amongst the hill sheep of Scotland. On arable land crops are grown to provide food at any time the farmer may think well to breed, and this is generally from Christmas to February with the Down breeds which are often required to supply Easter fat lambs, or are expected to turn out as fat tegs some time between the following November and March. The Dorset ewes which come into season exceptionally early can be made to throw their lambs in October in readiness to meet the Christmas fat lamb market, and those which come shortly after these supply the lamb market until the Down lambs are fit to kill. A great many of the Dorset fat lambs are got by Hampshire rams, the cross with the Down breed tending to improve the quality.

The strength and beauty of sheep-stock depend to some extent on the number of females that the ram is allowed to serve. While he is young, fifty or sixty should be the utmost extent; as he advances in years, the number may be gradually increased, but should seldom exceed eighty and never a hundred. Without these precautions, the lambs might not only be deficient in number, but also in strength. When the ram is allowed to run with the ewes, fifty of the latter is the usual number he is allowed to serve.

The following is a brief account of the management of ewes throughout the year.<sup>1</sup>

The management of the ewe flock varies somewhat with the breed, and also according as the flocks are kept for breeding pedigree stock, or only store animals. Where ewes are kept for breeding first class rams, which are expected to realise high prices, they are allowed rather better food than in the ordinary cases. An ordinary lamb ought to have cost not more than about 10s. when it is born, whereas highly-bred lambs have often cost 20s. at birth. Some of the difference is of course caused by the greater cost of the parents; but during the twelve months from lamb to lamb they are differently treated. On most farms the ewes are looked upon as scavengers, cleaning up rough food, much of which would otherwise be wasted. They rarely get the first run over a crop, but follow other sections of the flock. Highly-bred flocks receive more liberal treatment—not always to their advantage—and frequently have the first run on keep unless food is very short.

After lambing the ewes are as a rule kept well for the sake of the lambs, but at weaning time they are shorn and placed on short commons

<sup>1</sup> Sheepbreeders should read two papers in the *Journal of the Royal Agricultural Society*, "The Lambing Pen," by Harold Leeney (3rd series, vol. vii., 1896, p. 662), since published as a 6d. pamphlet, and "Abortion, Barrenness, and Fertility in Sheep," by Walter Heape, M.A. (3rd series, vol. x., 1899, p. 217).

to check the flow of milk. They are kept as scavengers until a fortnight before the tugging period, when it is desirable to get them into an improving condition by giving them a run on rape or green mustard, in order to bring them into season earlier, and to make them breed doubles. Before breeding the ewes should be examined, and any which have broken mouths, deformities, bad udders, or which put their wethers, or gave other trouble at lambing, or are not true to type or breed, should be culled to be fattened off, and their places should be filled with a selection of the best two-teeth tegs or theaves. After tugging they may be kept on sparser rations, getting a run over pastures and stubbles.

It is now generally agreed among flockmasters that there is considerable risk attendant on feeding roots to in-lamb ewes except very moderately. It has been observed that after a poor root season there is a better yeaning time and a healthier crop of lambs than when roots are plentiful. On the other hand, perhaps, there are few districts in which heavier falls of lambs are obtained than in some of the almost purely arable, where for want of pasture the sheep are kept on roots for some time before lambing; where this is the case the ewes are supplied with a considerable quantity of dry food daily. It is probable that the want of success when the ewes are kept on turnips is due more to the want of nutritious food than to any injurious principle contained in the roots. Turnips contain very little nutritious matter except sugar, and this cannot supply all that is necessary to keep up the health of the ewe, and to build up the young lamb within her, and she either fails herself or the lamb goes wrong. If a fair allowance of dry food is given with the roots, and especially if a small quantity of nitrogenous food, such as malt-dust, bran, peas, or cotton-cake, is given to the ewes during the month preceding lambing, a successful lambing season may be expected. This is different to the practice of making ewes too fat, in which case harm is done; the endeavour should be to make the ewes muscularly strong, and not fat. The greater success with ewes in seasons when roots are scarce is based on this principle, for then their diet has to be augmented with plentiful supplies of dry foods which contain nitrogenous in addition to starchy matter.

As soon as the ewes are expected to begin to *yeen*, they should be separated from the rest of the flock, and placed in a more sheltered paddock, and brought to the stack-yard, or to some sheltered place, every night when the pastures are not too far off. Where they are at a distance from the farm a spacious littered fold or shed would be a great improvement; on one side of it should be a warm cottage-hut, provided with a chimney, and a stove for warming milk, and also with a bed, on which the shepherd may lie down. Here he should sleep during the lambing season, in order that he may be ready to watch, assist, and tend any ewes that may be about to lamb, and, if necessary, to give aid. Some farmers have huts of this description on four wheels, to draw about with the flock wherever the sheep may be, and, on extensive downs, this is an excellent plan. But, on farms of a moderate size, it is preferable to have one or two well-sheltered enclosures, to which the flock may be taken without any distant driving; for, although the fold may

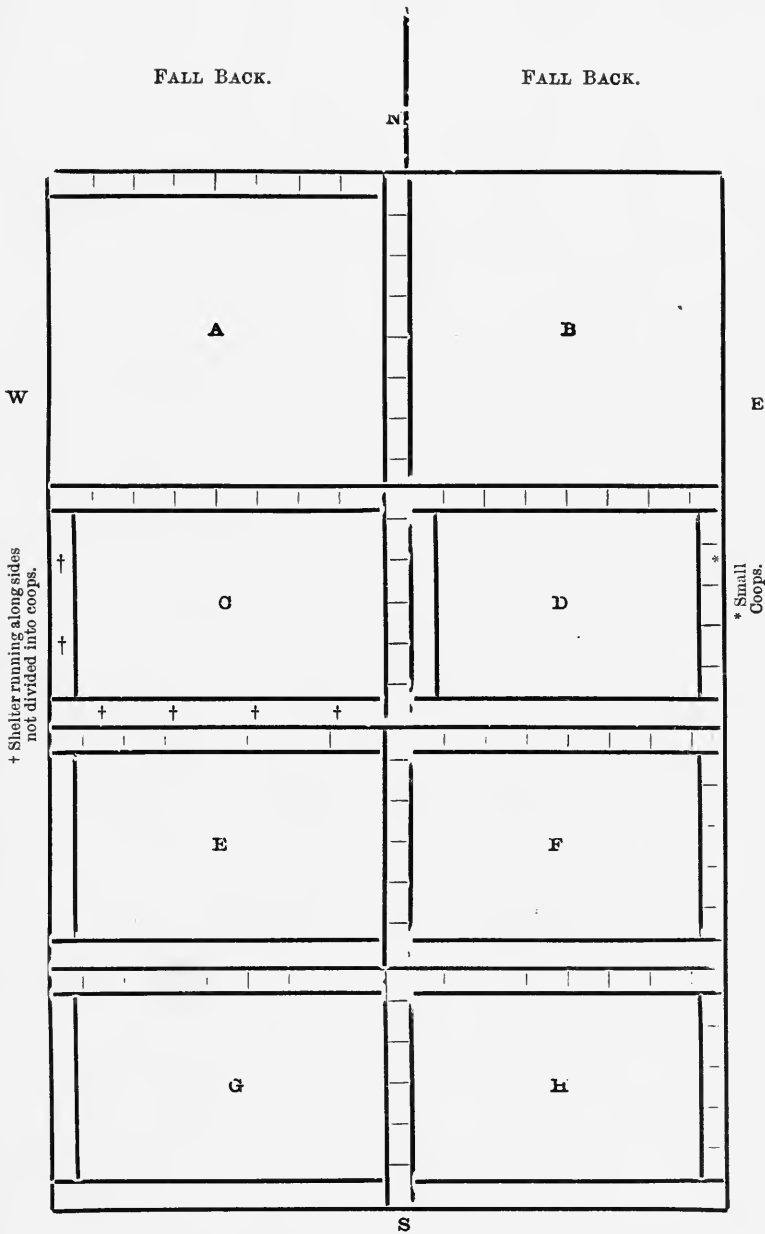


Fig. 130.—Wiltshire Open-field Lambing Pen.

be useful in very exposed situations and inclement seasons, yet the practice of folding ewes at lambing time is generally objectionable.

No method of making a temporary lambing yard excels for cheapness and convenience the *Wiltshire open field lambing pen* (fig. 130), which is

generally placed in or adjoining a field in which roots are growing, and it is usual to have a stack of straw either standing somewhere along the north side as shelter, or else in the pen itself so that there may be little trouble in littering the pen. At first the pen is very simple, as A and B,—A for the forward ewes, B for those not so forward. A contains a number of coops or small pens, a hurdle square, into which the ewes are drafted as they lamb; these are placed on the north and east sides, and sometimes all round. A "fall-back" is provided for each lot for exercise and feeding. When the lambs come quickly, two more pens are added, C for ewes with ram lambs, and D for ewes with ewe lambs. These are also provided with shelter coops round the north and east sides for the twin-lambs, and with sheltering hurdles laid up all round. As the lambs grow, the bigger ones from C are drafted into a fresh pen E, and from D to F.

The young "double couples" or twins are put into a separate pen G, and the older ones into H. These sub-sections are multiplied as the lambs increase in numbers, so that they and their mothers may be fed specially. As the lambs get stronger they are allowed a run out on some green food, and often they are taken right away from the lambing pen, and provided with a pen to themselves. It is not uncommon to keep a cow in a temporary shelter near the lambing pen to provide milk for those lambs which do not get sufficient from their mothers.

The means of providing shelter round the pens is very simple. First the pens are formed with a double set of hurdles about 8 inches apart, the space being filled with straw. Farther inward stout fir stakes are driven, on the tops of which battens about 4 inches by 3 inches are nailed, and on these stuffed hurdles are laid showing a section as in fig. 131.

The care of the ewes and lambs is of course the shepherd's chief duty while they are in the lambing yard. It is a mistake except in the case of very small flocks to expect him to attend to other portions of the flock. The shepherd must be in attendance night and day, as it is impossible to tell exactly when assistance may be needed by the ewes; he cannot give that attention to the lambs which they require if he is obliged to be elsewhere. During the day the shepherd has to look to the feeding of the sheep, the littering of the pen, the condition of the ewes' udders, and the general health of the lambs; and he should get his work in a forward condition, so that by night he may have nothing to do beyond attending to the ewes about to lamb, and to the weakly lambs which require suckling. The ewes will most probably be out on roots or pasture, and will not require much food to be cut, as it is better that they should take gentle exercise, and this they can get while foraging for themselves. They will, however, require coarse dry food, such as hay or hay-chaff, which should be given night and morning; and, if cake is allowed, it must also be prepared. The shepherd rarely has time to see to outside work, so this should be handed over to a labourer.

When the ewe is about to lamb she becomes uneasy, and draws away from the rest of the flock; her tail seems to stand out higher than usual, which is caused by the falling apart of the pelvic bones to make way for the lamb. Shortly before lambing the water-bladder appears, and



within a little time the lamb's feet may be seen to protrude. If the lamb is healthy and is in a natural position the two fore feet appear with the nose resting on them ; when this is the case there is not much difficulty unless the ewe has particularly little room, or the lamb's head is unusually large. In the latter case, the shepherd can usually get the lamb away by first drawing out the legs, then working the head out by pulling at the legs and easing the head with his fingers. If a ewe can lamb without assistance she is better left to herself, for if the lamb is drawn away injury may be done to the ewe, and inflammation may supervene. When assistance is given, the lamb should be drawn out straight, but in a slightly downward direction—towards the hocks.

Several forms of malpresentation are not uncommon: the most simple

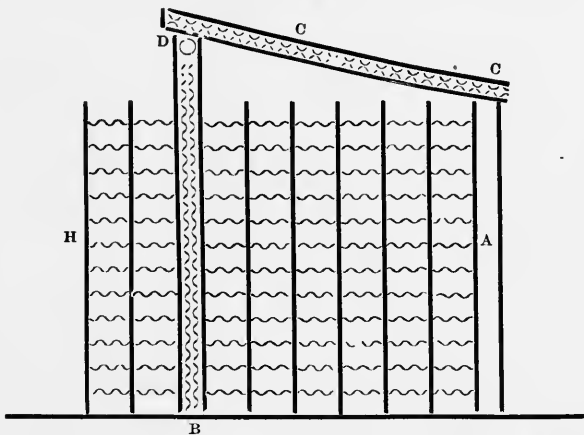


Fig. 131.—Section of Outer Fence of Lambing Pen.

A, space between two parallel lines of hurdles, filled with straw. B, 8-foot stake, or post, supporting D, tie battens. C, C, covering hurdles, overlaid with thatch or furze, to form roof ; they are supported at D, and by the two hurdles at A. From A to H is one hurdle in length, and the coops. or pens are thus divided from each other by wattle hurdles.

is that in which one leg is turned back, in which case it must be brought forward so that the lamb lies in the natural position. At other times both legs are behind, or the head is bent back, and these must be put right, which will often necessitate the lamb being pushed back some distance to allow freedom to the shepherd. Occasionally the lamb comes backwards, and unless it is a small one, it is very difficult to bring forth. It may indeed be necessary to push it right back and to turn it altogether round, which is an arduous task, especially when the ewe is young or has not much room. It is said by some shepherds that cutting away should never be resorted to, but in extreme cases it is often done, as the ewe's life is more valuable than the lamb's. If the shepherd cannot get the lamb away otherwise it is better that he should destroy the lamb rather than expose the ewe to too great risk.

The most troublesome cases to deal with are those where the ewe

will not attempt to bring the lamb forward although its full time has expired, and all the usual signs of lambing are present. It is often found that there is a dead lamb present on occasions like these. Artificial pains may be induced by ewe-drinks containing ergot, but though they are doubtless of use, they cannot always be relied upon.

As soon as the lamb is born the caul should be wiped away from its nose, and if it does not sneeze so as to open a passage to the lungs—as is often the case when a lamb has been partially strangled during protracted labour—the shepherd should blow hard into its nostrils and mouth until the windpipe is cleared and breathing begins. The ewe's teats should be drawn to see that they are not blocked with dirt, and that she is possessed of milk. She will lick her lamb, and in a very short time it will get on its legs and suck without assistance. When the ewe is short of milk the lamb may be suckled from another ewe with a surplus quantity, or it may have cow's milk; this latter, however, often produces scour, and therefore is not so good, but it is impossible in most cases to get through the season without having recourse to it. Lambs may be made to take to foster-mothers very quickly, but the ewes are a little more particular, though, with the exercise of patience, and some skill, the difficulty may be overcome in the course of a few days. The substituted lamb should be covered with the skin of the dead one it is to replace, and if this is not sufficient the ewe must be tied up so that she cannot avoid the lamb. Dead lambs and sheep should be buried, otherwise the dogs may become sheep worriers if they get accustomed to gnawing carcasses. A plentiful supply of a mixture of carbolic acid and olive oil (in proportion of 1 to 7) should be kept in the sheep-yard to pour inside the ewe after she has experienced much difficulty in lambing, or has thrown a dead lamb, and carbolic acid should always be available so that the shepherd may rinse his hands after handling any sheep which does not appear absolutely free from disease. It is very necessary to keep the ewes' teats sound, otherwise they will not allow the lambs to suckle, and mammitis or garget, will result. Ewes should be got out of the lambing pen as soon as possible, or foot-rot may attack them. When taken out in very cold weather the lambs should have shelters provided in the fields.

Perhaps the most serviceable mode of giving practical information on the subject of the food supply to the flock will be to quote descriptions of the methods adopted by several prominent flock-masters with different breeds.

Mr. Charles Howard, of Biddenham, Bedford, thus describes his practice with his famous flock of Oxford Downs:—

“The ewes are generally put to the rams about the second week in August, and are from that time, with the run of the stubbles, the scavengers of the farm. I usually grow some white peas for the use of the rams; immediately these are harvested, the stubble is either ploughed or dragged, and mustard sown, which is ready at the latter end of September, upon which the ewes are folded at night. After this is disposed of, they run the grasses, and are folded at night upon the

land where the mangel has been drawn. A few kohlrabi are generally sown with the mangel, which are left for consumption by the ewes. After this they generally consume the cabbage sprouts, and are then supplied with some dry food. Approaching lambing time, they are placed in comfortable yards at night, and have a supply of chaff and straw, with some bran, oats, and mixed cake. Previous to lambing, I give them as few roots as possible.

“After lambing, they run upon grass adjoining the yards, and when the lambs are strong enough, they are placed upon the roots, with lamb hurdles for the lambs to run forward on the tops, and have a supply of bran, oats, and cake crushed very small. I think it desirable to get them out of the yards as soon as possible: this of course depends upon the weather and the strength of the lambs. After the turnips are consumed they are placed upon winter oats and tares, or the grasses until the clovers are ready, the ewes being plentifully supplied with mangel. The lambs are weaned in June, and are placed as soon as possible on the aftermaths of clovers and grasses, when a supply of cabbage is drawn to them, which generally lasts until September, when a few white turnips of an early variety are ready for them, upon which they are folded at night. The feeding tegs get permanently settled about the middle or latter end of October upon roots, which are sliced for them, and have a supply of clover chaff and  $\frac{1}{2}$  to  $\frac{3}{4}$  lb. mixed cake and split peas, which is increased as the season advances to 1 lb., being then composed of mixed cake, split peas, beans, peas, maize, and a little malt. The ram tegs are somewhat more generously treated. The breeding ewe tegs get a good supply of clover chaff and about  $\frac{1}{2}$  lb. of mixed corn and cake. The feeding tegs are ready for market between February and April, being between twelve and fourteen months old. Those sold in the former month are in the wool; those in April are shorn, and weigh from 10 to 12 stone, and as they are of excellent quality they command a good sale for the London market.”

Mr. T. S. Minton's custom with his well-known flock of Shropshires is to have the lambs arrive in February and March. During March, April, and May the ewes and lambs are on seeds one and two years old, the ewes receiving a few mangel at first and the lambs a few split peas (in a pen made on purpose in the centre of the field) during the latter part.

In June the lambs are weaned and put on a sweet pasture, receiving a small allowance (two or three ounces) of corn, where they remain until the clover aftermath is ready, which generally lasts them July and August. For the last few years the custom has been to shear the lambs in June, on the ground that they grow better, are not troubled much with the fly, and keep so much cleaner when on the turnip land in winter.

In September lambs go on to the young seeds on the cleared barley stubbles, still receiving their corn; there they remain until the middle of October, when they are gradually moved on to white turnips, where in the course of a week they remain altogether, and now receive a quarter of a pound of corn and some clover hay in racks. The hurdles are moved daily, and the lambs bite their own turnips for the first

month, when they are cut into fingers. White turnips generally last till Christmas, when swedes commence. The allowance of corn is then gradually increased to half a pound. When on turnips they receive their corn the first thing, then a feed of turnips. During the morning the clover is put in racks, and another feed of turnips in the afternoon.

Mr. Henry Dudding, of Riby Grange, a highly successful breeder of Lincolns, thus describes his practice :—"My plan is to breed from 350 ewes on a 650-acre farm, which will, as a rule, produce all sheep required the year round, bringing into the flock annually 100 of the best young ewes. The remainder are sold to foreign buyers, or fed off with the old draft ewes on turnips, with the addition of cake, corn, and chaff, and are all sold by Christmas—up to 30 lb. a quarter. The greatest attention is paid to the lambs after taking them from the ewes in July. As a rule, they have all got to eat well from the troughs a mixture of linseed-cake, crushed oats and locust-beans, a little bran, malt-combs, and a little cut clover, which make a most healthy mixture, at a cost of under £5 a ton. The most critical time is before getting them on turnips in October without a loss, due especially to the cough which is caused by the throat-worm, and in many cases shrinks them 10s. a head. After the hogs, as they are now termed, have got well hold of turnips, they improve rapidly without much loss. The great aim in ordinary flocks is to get these sheep fresh or fat for sale in March or April, about a year old. The majority are sold in their wool for grazing on the marshes." This and the two preceding examples are taken from contributions to the "Live Stock Journal."

The following is a description of the ordinary management for meeting the wants of a Hampshire Down flock on a Hampshire farm.

The sheep are provided with an endless succession of green fodder and roots throughout the year, and this is aided at the critical period of spring by the water meadows, which constitute an important feature on the farms. In early spring the flock is on roots, and these are seldom pitted, but are left to throw up tops over which the young lambs are allowed to run before their dams. Late in March the water meadows are folded, the lambs still being allowed to run forward. Next follow rye and winter barley, trifolium, vetches, rape, clover, cabbage, and early turnips, which bring us once more to August and the first symptoms of winter feeding. Mangel and cabbage are both relied on during the hot months, and are used as a variation from less nutritious diet. The sheep are, indeed, constantly changed from one food to another, and are generally receiving at least two sorts of natural herbage daily. Cake and corn are liberally given. The ewes get 1 lb. per day, and as the season advances this quantity is gradually transferred from dams to lambs, until the latter receive from 1 lb. to 1½ lb. daily. The favourite dry foods are linseed-cake, dry beans and peas, bran, and malt.

A Hampshire Down lamb in mid-career is often revelling in ten or eleven changes of food in the course of a long summer day. At early

morn he rcams over dew-besprinkled vetches, and as the sun rises higher in the heavens he is attracted to mangel by the familiar sound of the cutter. Thus regaled, he is strengthened by an allowance of cake mixed with split beans, peas, malt, and other pleasant and toothsome additions. The shepherd's voice is next heard calling him to cabbage, and perchance as the day declines he rests amidst the grateful and cooling shade of rape leaves towering above his recumbent form, while ever and anon he nibbles playfully at the tenderest and youngest shoots. The ever-watchful shepherd now leads his flock to pastures new in the shape of clover eddish or aftermath, where they "spread" and amuse themselves for a brief space, and lastly he takes them back to their fold of vetches, which enlists their sated attention until sundown. Such is the enviable day of a Hampshire Down lamb in July.

Under such treatment it is no matter for surprise that the young creatures should grow rapidly. A lamb dropped February 1 will weigh about 18 lb. at birth. The same lamb may easily weigh 150 lb. on August 1. It has in this case increased 132 lb. in 181 days, or at the rate of .73 lb., that is, close upon three-quarters of a pound daily. Considering that this is an average increase taken over the entire period of the lamb's life, the growth during the later stages must be rapid indeed.

Lambing lasts from the beginning of January to mid-February. Previous to lambing the ewes are kept on a very restricted quantity of swedes and a liberal allowance of hay. As yeaning approaches they are folded on grass, and allowed to spend a short time every day upon arable land, on swedes. As fast as they "come in" they are brought into the pen and receive a little cake and a few oats, as well as roots and hay. After a few days they are allowed to go out upon white turnips, still receiving the same diet as before in the pen. As soon as the lambs are able they are encouraged to run forward through creeps to nibble the young turnip-greens, and to eat a little fine linseed-cake dust out of small troughs. The quantity of food is gradually increased, thus *feeding the lambs through the ewes* as well as directly. By the middle of March the allowance of cake and corn is as follows:—

	lb.
6 bushels of mixed cake (44 lb.)	= 264
2 bushels of light oats (30 lb.)	. = 60
One-third sack of beans . . .	= 85

409

So that 409 lb. of dry food is given daily amongst, say, 485 ewes with their lambs. At this time the ewes are getting about 1 lb. of hay each in addition, so that the dry food amounts altogether to 1.85 lb. per head per day. No further change of importance takes place in the feeding until the latter part of March, when hay is gradually discontinued, and the sheep are run upon seeds and over the pastures daily. On March 31 they go on to the water meadows for the first time, returning to a fold of late turnips, then coming into flower. This ends the real winter feeding for the season. The sheep then begin

to be folded on rye, going also on the water meadows from eleven to three each day. This commenced the course of summer keep, previously mentioned, which is continued for five months.

We proceed to give an account of the management of young sheep throughout the year.

The early breeds, such as the Downs, begin to lamb at Christmas, and the greater number of the lambs fall in January and February. The males should be castrated when from 12 to 14 days old, a dry afternoon being chosen for the operation. As soon as the lambs can feed they are enticed to eat corn, the best forms of which at this stage are linseed-cake meal, pea-husk, and crushed oats; this is put into troughs placed outside the pens containing the ewes, and, if possible, on ground cropped with turnips, rape, kale, or kohlrabi, which carry succulent young shoots that the lambs very soon learn to eat. The lambs pass through lamb-creeps, which are hurdles specially made to allow them to run in and out of the pen, but will not permit the ewes to pass. When it is desired to hasten the lambs forward so that they may be fit for the butcher at Easter, or are to be got up in readiness for sale as rams in August and September, it is customary and advisable to give the ewes a liberal diet, part of which is cake, or cake, oats, and peas, so that they make a large quantity of milk, whereby the lambs are fed through their mothers. As much as a pound of corn is given to the ewes daily at first, and this is gradually diminished as the lambs eat more. As a rule, the ewe lambs which are to enter the breeding flock are not so liberally fed. As mixed a diet as possible is provided for the lambs, which, in addition to the corn already mentioned, receive split peas as they get older. Towards April they are put upon the autumn-sown catch crops, water-meadows if they are available, or other early meadows, or Italian rye-grass, the ewes receiving mangel to eke out the green food.

It is at this time that thousand-headed kale is particularly valuable, as in backward springs when there is a considerable period between the finishing of the root-crop and the growth of sufficient grass or clovers to feed, it affords abundant fodder; in fact, it is at its best if planted early in the previous year, about May. When the clovers are fit to stock, there is little trouble in finding food for lambs, but care must be taken when feeding a portion of the crop that there will be fresh food for them in the latter part of summer. If lambs are made to feed off a crop twice in a season, unless it has been mown between the times of feeding off, they are almost certain to become unhealthy. Therefore it is necessary to arrange the mowing and feeding, so that there may be a fresh bite until they are placed on roots in the autumn. Where grass is available the lambs will do well, but they must not be kept in one pasture too long. By July early cabbages and autumn-sown kale should be in readiness for the lambs, so that they may be folded on them at night.

The shepherd's duties in summer time, beyond providing food, are to keep the sheep sound in skin and feet. The lambs should be dipped

immediately after they are weaned, to prevent attacks by fly, ticks, lice, and scab. There are several dips which are employed for this purpose, and it is labour well directed to dip the lambs at weaning time, and again in autumn. In very moist, mild weather, or when the lambs scour and become dirty behind, the effect of the dip may be overcome, and the fly will strike them, as a result of which the eggs will hatch and, unless the shepherd is on the alert to suppress the maggots, the latter will seriously molest the young animals. There are many preparations which will destroy the maggots, but some, especially those which contain mercury, are liable to injure the sheep.

If the stubbles are in good order the sheep may be put on them for a short time daily.

In October they should be feeding on turnips and cabbages, in addition to a run on grass or leys, if these are still sweet, and receiving chaff and about half a pound of corn daily—more, if it is desired to get them out fat by December; less, if it is intended to run them through winter. By November they will be started on the winter feeding, and the management alters somewhat. Nothing is so good for them as cabbages, and they will require only chaff and corn in addition. Many flock-masters still put their trust in swedes, though it is wiser not to feed swedes until they are thoroughly ripe, so that they come into use after the cabbage season is over. The breaking-in of sheep to roots is known to be so dangerous, as leading to scour and even death, that the animals are considered to be worth a shilling more a head when they are used to them, than when the risk has still to be run.

When the lambs, now called tegs or hoggets, are under winter management, the duties of the shepherd are onerous. The first thing a shepherd should do on reaching the pen in the morning is to put all the sheep up, to see that all are right, for it often happens that one may be ailing, and when sheep ail they require prompt attention or they may die. If more than one is unwell it generally indicates that there is something wrong in the system of feeding, and he should search for the causes, and if nothing else appears to be the source of injury he may safely conclude it is the corn, and this must be withheld until the master has looked into the matter. Any sheep in good condition that becomes unwell should be bled at once, and if it does not recover quickly it is best to save the carcass by cutting its throat, and making good mutton of it. Having ascertained that all the sheep are right, the shepherd should proceed to give the sheep their chaff and corn, which are best mixed, as fast eaters get less chance of appropriating an undue share of corn than when the corn is put into the troughs by itself. If any sheep does not come to the trough, the shepherd may conclude he has overlooked it before, and he must keep his eye on it, and bleed it if necessary, watching it lest it should suddenly die. Having given the sheep their corn, he should at once start to fill the root-troughs with sliced roots, and continue to fill them until the sheep begin to fall back to rest, and to digest what they have eaten. He may then get his own breakfast, and after-

wards employ himself in setting a fresh pen, getting up the chaff and corn in readiness for the next day, attending to the sheep's feet, cutting off dirty locks around their tails, or digging out small patches of couch in the pens, so that none is trodden into the ground. About noon he should refill the root-troughs, and then get his dinner, after which he can continue his other duties as in the fore-noon. Towards evening he should again fill the root-troughs, and give the sheep the second half of their corn and chaff. Having satisfied their appetites, and made sure they have sufficient food to last them through the night, he should go round the hurdles and see that the pens are secure. In frosty weather he should loosen the hurdles and stakes, so that none may be frozen in. After rains, or during the early parts of thaws, he should be particularly careful to see that the stakes are well driven into the ground, or the hurdles will fall down with but little pressure of the sheep or wind.

From December to April the sheep will be sold out as they become fit for the butcher. Those sheep not fattened out on the roots will be run on to the leys, and topped out on them as shearhogs, but with the Down breeds the number of sheep kept until they are shearhogs diminishes, as the aim is now to get them out as tegs during winter. Some of the tegs are sold in the wool, while others are shorn previously to being sent to market; these latter must be provided with cloth jackets, or they will be injured by the cold.

The management of long-wooled sheep is very similar to that which has been described, except that the lambs come later, and are generally kept on grass during the first few months of their lives. Some run on grass throughout summer, while others run on leys. Many are wintered on roots, but as they are not forced out so quickly, they do not, as a rule, receive so much corn as the Down breeds. Some pass the winter on grass, their food being augmented by roots carted to them. In the spring they go on to grass and leys, and are fattened out and sold as they become fit for market. Some are sold before shearing time, while others are first shorn and then prepared for market, some not going out until they have fed off cole-seed and other crops of a similar nature, but there is a tendency to fatten them out earlier than was the custom a few years ago.

It is advisable to divide the flock into various sections, so that they may be treated separately in accordance with the purpose for which they are severally intended. Thus the ewes, fattening tegs, breeding tegs, wethers, and other sections should all be penned or grazed separately, and receive corn in quantity suited to their condition.

When a farm is thus stocked with a proper assortment of sheep, the owner should frequently inspect them, particularly in the winter; and either remove them into better feed, or dispose of those which do not thrive upon their allotted grounds, as he sees need. Independently, too, of these examinations, the shepherd should carefully watch over his charges, as they are liable to numerous maladies.

A very frequent evil is the acute form of inflammation, which pursues its course with almost incredible rapidity in autumn and



winter. In such cases, the sheep will lag behind, or separate himself from the flock, or stand with his head protruding, or begin to breathe with difficulty. Before the affection has proceeded far the animal will evince considerable uneasiness. There will be severe constipation; then the evil will suddenly change its character, and frequently violent purging will succeed.

Over-fed sheep are liable to be afflicted with a form of paralysis, which proves fatal if it is not attended to at once. The sheep does not come up to the trough with the rest, and lies apparently in little pain, but in a listless manner. The real cause is excess of nitrogen in the blood, which affects the brain, and this must be relieved; the common practice on the farm is to bleed the sheep, and if the sheep is not very bad this will generally put it right. If it has gone unnoticed too long, the sheep's throat must be cut to save the carcass. When several sheep are affected in this manner, it is a proof that the corn is too nitrogenous in its composition, and it should be changed to something of a more starchy nature. In practice the farmer takes off the corn altogether, which is correct; but it would be better to arrange the diet in the first instance so that it is not too nitrogenous, and in this way avoid the attack altogether.

The sheep are often unable to defend themselves against the attacks of flies during hot seasons, and in severe weather. Docking is now generally adopted as a means of preserving the health of the animals, keeping them free from ordure which they deposit on the fleece, and giving the animal a square handsome appearance in the hind quarters. We do not recommend it for breeding ewes in very exposed climates, as, while suckling, the tail affords considerable warmth and protection to the udder, but in any save the coldest districts the ewes are better docked.

Throughout the whole system of sheep husbandry the greatest attention is necessary on the part of the shepherd; he must regularly and frequently inspect the animals committed to his charge, and act promptly in all cases requiring his aid. From the nature of the hill shepherd's employment, which is usually exercised at a distance from his master's eye, he is under little control. As the property in his care is generally valuable, and always requires the closest attention, great circumspection should be exercised in choosing an experienced and trustworthy person for the office; and, when such an one is found, his services should not be grudgingly remunerated. This holds good to some extent with respect to the shepherd on enclosed farms. As a matter of business, however, the farmer should manage the flock, leaving the shepherd to carry out the details. In Saxony the shepherds have no fixed wages, but are allowed a profit on the produce of the flock. From the adoption of this arrangement the flock-masters derive great advantage, for the shepherds have no inducement to deceive them, but are themselves interested in taking due care of the animals committed to their charge. This practice has also been adopted, and with success, by some flock-masters in Scotland. It is certainly worthy of consideration, if not of trial.

*Cross-breeding.*—Mr. William Robinson, Willington, Bedford, has favoured us with the results of his more than thirty years' experience in the cross-breeding of sheep, he having commenced as long ago as 1860. He began by crossing a Lincoln ram with Leicester ewes, crossing their female produce with a Hampshire ram three times. He next used a Cotswold ram twice, returning to Hampshire Down after a year or two. He then tried Oxford Down rams, and afterwards again used Hampshires, returning, however, to Oxfords, which he has used for the last few years, but went back to the Hampshires in 1891, with the object of getting more lean meat and less wool. A trial made with a Shropshire ram upon half-bred ewes did not prove successful.

On account of the demand at the local markets for sheep with black faces and legs, and also of the low price of wool, Mr. Robinson has found that, during the last few years, the Hampshire and Oxford has proved the most successful cross. As to the effect on the mutton and wool, the cross from the Leicester-Lincoln ewes and the Hampshire ram did not lose any weight in wool, whilst the mutton was 4*d.* per 8*lb.* more in value than the long-wool cross. An Oxford ram with Hampshire ewes has proved the best cross of any.

In reply to the question whether pure-bred sheep are more successful than crosses, Mr. Robinson says, "If you breed and sell either stores, or feed all your sheep, I consider that, in a county like Bedford, crossing pays better than keeping a pure breed." Cross-bred sheep scale heavily, 20 stones and upwards at 20 to 22 months old, 10 to 12 stones (of 8*lb.*) at one year old. Fleeces weigh from 10*lb.* down to 8*lb.*, whilst in some few cases cross-bred sheep have shorn 12*lb.* at one year old.

Our obliging correspondent states that he has not tried pure Downs, as he considers they would not do well on land not containing chalk or lime. He does not think sheep can be "got up" for show so well on light as on heavy land, if they are intended to be exhibited over one year old; in the case of lambs for show he would, however, prefer light land, so that he could have early green food grown on arable land. He has generally had a large number of lambs in proportion to the number of ewes, and also plenty of milk, but these are incidents which are largely dependent on the season, as ewes with lambs require natural green food in order to suckle well. Mr. Robinson adds that in order to compete with the imports of foreign mutton our home farmers should endeavour to produce the finest quality of meat without regard to wool. He favours the raising of small sheep with plenty of lean meat,—“foreign mutton is not equal to the best English, such as a good Sussex Down, which now commands as high a price as any in the market.”

We are indebted to Mr. R. M. Bodger, Cardington, Bedford, for the following details. "As to which cross is the best, much depends upon locality and fancy. I like the Hampshire Down ewe and Cotswold ram, or Hampshire ewe and Oxford ram. By exercising ordinary care in the selection of ewes and ram, you are safe to get good-looking half-bred lambs. The real difficulty in a mixed or half-bred flock is as to what to put the first cross with. My experience is that to keep size, flesh, wool, colour, and character, a pure-bred ram of some distinct

breed must be used, of course exercising judgment as to what the flock is deficient in. This, in a few words, is the management of my own flock. I could not enumerate all the crosses of sheep now in the several counties, but wherever numbers of lambs are seen growing hair and not wool on their legs—more like goats than sheep—this is one of the surest signs of improper crossing. Of one thing I am certain, that, if properly managed and not intended as a show flock, or a ram-breeding flock, no sheep fatten with so little extra corn as the cross-breeds.”

Instructive papers on “Cross-bred Sheep,” by Messrs. H. J. Elwes and W. J. Malden, appeared in the *Journal of the Royal Agricultural Society*, 3rd series, vol. vi., 1895, p. 221.

The *Shepherd's Dog* (fig. 132) performs so important a part in the management of sheep, that some notice of his qualities cannot be deemed irrelevant to the subject. The variety delineated occurs chiefly



Fig. 132.—The Scotch Collie or Sheep Dog.

in the extensive sheepwalks in the northern parts of Britain, where the purity of its breed appears to be preserved in the greatest perfection. His docility and sagacity surpass those of every other variety of the canine race. Obedient to the voice, looks, and gestures of his master, he immediately understands his commands, and almost his wishes, and instantly and cheerfully executes them. A well-trained dog of this kind is an invaluable acquisition to a shepherd. Public “trials” of sheep-dogs take place in Wales and Scotland, and are occasionally held in some parts of England, but it is open to question whether they have much effect in stimulating shepherds to train young dogs. Amongst the Down breeds, upon the arable sheep farms of England, the “bob-tailed” sheep-dog is mostly seen.

## CHAPTER III.

## THE FEEDING ON PASTURES, THE FOLDING, AND SHELTERING OF SHEEP.

THE successful feeding of sheep, on the first of these methods, must greatly depend on the quality of the pasture intended for their reception, and the resources at the farmer's disposal for supplying them with food during the trying winter months. It will always be necessary to suit them to the pasture, and on no account to procure sheep from grounds of a quality superior to those which are destined for their support. The larger breeds, as a rule, do best on good and luxuriant pasture, where they have not to travel too far for their day's food, while the smaller kinds are best adapted for the less fertile tracts, and for a shorter bite of grass.

The tendency with most sheep-keepers—though an exception exists in the case of mountain flockmasters—is now to bring their sheep into the market as early as possible, maintaining them in good health and condition throughout their lives, as the mere keeping alive without any improvement in condition is expensive and unprofitable. The aim is now to dispose of the sheep while they are tegs, and the early lambing breeds are usually sold at from 10 to 15 months, being fattened out on roots during winter. The longer-woolled sheep are not brought to quite so rapid maturity, and though some are got out young and during spring, a large proportion are carried through the winter on roots or grass, and then sold to be topped up on rich pastures and leys, by which means profit is made of the valuable fleece, which is clipped and sold separately. The time at which they are fattened out of course depends to a great extent on the way they have been treated when lambs. Those which have received corn are naturally fit for killing before those which have only received ordinary bulky farm produce.

Before turning sheep into pastures, particularly water-meadows, and also into those places that are subject to the rot, it will be expedient to give them hay or cut straw. When any kind of dry food is given, plenty of water should be supplied, particularly during the intense heat that usually prevails in the middle of the summer, and often renders the grass as dry as stubble. Clear running water is always to be preferred where it can be obtained. While ewes are suckling, they should have access to water, otherwise their milk will be diminished in quantity or injured in quality, or they may become covered with a mangy eruption. Some caution is required when sheep which have been long kept from water again have access to it.

Wet grass land is highly dangerous at certain seasons, as sheep are liable to contract liver-rot or fluke, which in wet years has been known to more than decimate the flocks of this country.

Soft boggy grass is apt to give sheep "scald," which is followed by foot-rot. Perhaps the best preventive is pasturing them in such positions that they will have some hard-surfaced parts to go upon.

Mr. Charles Howard, writing in the Journal of the Royal Agricultural Society (Vol. I., 3rd series), 1890, gave the following recipe, which he had found effective for the cure of foot-rot in sheep:—

2 oz. verdigris, powdered.  
 2 oz. armenic (Armenian bole), powdered.  
 2 oz. blue stone (blue vitriol, sulphate of copper), powdered.  
 $\frac{1}{4}$  oz. caustic, powdered.  
 $\frac{1}{8}$  pint turpentine.  
 4 oz. Stockholm tar.  
 2 oz. hog's lard.  
 2 oz. oil of vitriol.

Pour the oil of vitriol on last, and very slowly, or it will boil over. Keep stirring with a stick until it leaves off boiling.

Mr. Howard adds:—

"The course I pursue is to draw out all the lame sheep, take them to some dry hovel or shed, thoroughly well pare their feet so that the disease is bottomed, and then apply the ointment. The sheep remain in the shed, or in a dry gravelled yard, for at least one night. I am quite sure that, by the use of this ointment, and with proper attention, the disease can be kept under. I fear that, in many cases, the shepherd is not sufficiently relieved of his ordinary duties to attend adequately to the sheep's feet. When the disease is prevalent he should have all the assistance he requires. It is most desirable that the sheep's feet should be every few weeks properly pared, a practice that will tend very much to retard this disease. Foot-rot is one of the most subtle of diseases. I have known my sheep to be quite free from it upon one farm, but if taken to another, upon which there was pasture with abundance of trees, they would within a very few days begin to fall with it."

The following mode of dealing with foot-rot is recommended by Mr. David Buttar, Corston, Coupar Angus, N.B.:—"Pass the whole flock twice during the year through a solution of arsenic, which is thus prepared. Boil 2 lb. of arsenic with 2 lb. of potash (pearl ash) in 1 gallon of water over a *slow* fire for half an hour. Keep stirring, and at any signs of boiling over pour in a little cold water; then add 5 gallons of cold water. Put this solution to the depth of 1 in. to  $1\frac{1}{2}$  in. (just sufficient to cover the hoofs of the sheep) in a strong, well-made, water-tight trough, 12 ft. long by 18 in. wide, and about 6 in. deep, with narrow strips of wood nailed across the bottom to prevent the sheep from slipping. The trough must be set and fixed perfectly level alongside a wall or other fence in some out-of-the-way place. It should be provided with a good waterproof lid, secured by a padlock, so as to prevent the possibility of danger from any poison which might be left in the trough. There should also be a wooden fence on the other side of the trough, extended somewhat at

the entrance end to guide the sheep into it, as indicated in the diagram (fig. 133).

“ Before the sheep are driven through the trough their feet should be well pared ; then walk them quietly through and let them remain in Pen No. 2 for half an hour or so before taking them back to their pasture. If sheep are badly attacked I would recommend drawing out all the affected ones, and passing them through the trough a second time, after remaining for half an hour in the pen. Should this not cure them, repeat the process in a fortnight or three weeks' time. Having got free from foot-rot, the passing of the flock through this solution twice a year will completely prevent any new attack. Before adopting this plan my sheep were scarcely ever free from the disease.

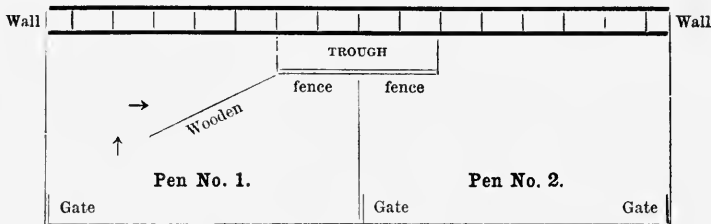


Fig. 133.—Plan of arrangement for Dressing Feet of Sheep.

Now I have not a single case, and have had none since I first resorted to the practice in 1885.”

The best time for turning sheep into summer pasture is in April or May, according to the lateness of the season, when every attention should be paid to proportion the number according to the luxuriance of the grass. It is worthy of notice, that by pursuing a system of *close feeding* as is fairly practicable, the plants will be prevented from running to seed, and the grasses that are coarse and unprofitable will be kept down, and the pasture rendered sweet and valuable. As the number to be allotted to an acre depends on the weight of the stock, the richness of the soil, and the forwardness of the pasture, it must be evident that no general rule can be applied to this branch of management. It must be wholly regulated by circumstances. A certain number of store cattle should be allowed to run with the sheep, otherwise all the finer bottom grasses will be eaten up, and the long and coarse ones remain untouched. On some pastures which are kept entirely for sheep-feed this is not necessary, as by being constantly grazed with sheep the herbage has been rendered fine, and farmers have a strong objection to turning in any other stock.

Of late years, it has become a frequent practice to soil sheep during summer with the various artificial grasses, and to supply them with corn or cake, as well as green food, during winter.

Cole-seed, cabbage, and thousand-headed kale supply excellent food for sheep during the winter, particularly towards the close of that

season; but in most situations turnips, swedes, and kohl rabi constitute the farmer's chief dependence for the winter-keep of his sheep-stock.

There are various methods by which turnips may be supplied to sheep. Some farmers turn the sheep promiscuously into a large section of a field fenced off, and allow them to eat the roots at pleasure. Another practice, not so common, is to enclose the sheep in such a space as they can clear in one day, advancing progressively through the field until it is cleared. But, in either case, care should be taken not to turn them on to fresh roots very early in the morning until the dew is off, lest by eating the wet leaves they may possibly become affected with hoven (page 548). Another method is, to pull such a quantity of turnips as will be consumed in a few days, and cart them off the land to the sheep pastures; and, in wet weather, or when it is not an object to feed off the turnips on the ground on which they are grown, this is a commendable method.

The best sheep managers pull most of the roots up and slice them with a turnip-cutter before giving them to sheep. This is doubtless the most economical method of feeding the root crop, although the cost of getting up and cutting is considerable. When the crop is got up and sliced there is practically no waste of roots, and the sheep being able to satisfy their appetites more quickly have longer time to rest, and they consequently fatten sooner than when they have to devote the greater part of the day to gnawing hard roots. Rest is essential to all fattening animals, and sheep require it as much as any.

The most convenient way of feeding sliced roots is to have the crop pulled and thrown into heaps a chain square apart: these heaps in a 20-ton crop would contain 2 tons each. Therefore, allowing 1 cwt. per sheep per week, the pen  $\frac{1}{16}$  of an acre would carry 280 sheep one day, or if the sheep were bigger and required as much as 22 lb. per day, the heap would furnish a day's food for 200 sheep. It is usually considered that a man can clean and slice sufficient roots for 200 sheep, provided they are heaped for him. In addition to this, he can "shepherd" them, which includes setting hurdles, getting chaff and corn, keeping the sheep's feet sound, and their bodies free from dirt: and, if the land is not very foul he can dig out occasional pieces of couch in front of the pens. If he has no cutting to do, the shepherd should look after 400 sheep.

The practice of allowing sheep to graze or gnaw their roots is most common on light chalk soils, where the greater part of the root crop consists of soft turnips, or green topped plants such as rape.

When sheep are folded upon turnip-land (swedes)—that is, where the turnips have not been taken up—the great purpose of the system is to manure the soil, and also in the case of light lands, for which it is specially adapted, to tread down and consolidate it for succeeding crops, as wheat, which requires a firm seed-bed. In carrying out these two objects, care should of course be taken to arrange the feeding off of the turnips in such a way that the manuring and consolidation of the soil is effected as uniformly as possible. This is done by staking or divid-

ing off, by means of wood or iron hurdles, a certain breadth of the field containing as much space as will feed the sheep for a certain time, usually a week. The strip, if it may be so called, which is divided from the rest of the field by the two rows of hurdles (one now is only needed when the sides next the fences are being eaten off), should run in

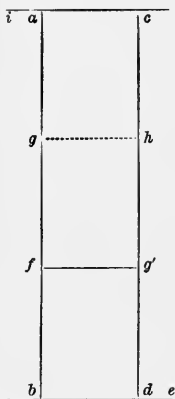


Fig. 133A.

the direction of the length of the field or the line of furrows, so that the plough can turn in the manure or dung of the animals as fast as each piece or strip of land is fairly eaten off. If the field is long, or the usual or average length, one end only, as  $b f g' d$ , of the strip is staked or hurdled off, say the south fence, as  $b d e$ . When that part is eaten off, the stakes crossing the strip at  $f g'$  are moved farther up, say to  $g h$ , and the sheep eat off the fresh turnips on the space of  $f g' h g$ . When that part is eaten off, the hurdles  $g h$  are removed, and the part  $g a c h$  left to be eaten off. In this rough type diagram (fig. 133A),  $a b, c d$  are the hurdles— $b d e$  the south, and  $i a c$  the north fence of the field. In all movements of the cross land hurdles, as  $f g', g h$ , the back pieces, technically termed the back feeds, or fall-backs, as  $b f g' d$ , are thrown in to the new pieces, as  $f g h g'$ —so that the sheep at the first removal of the fence  $f g'$  have got the whole  $b g h d$  to roam over.

In these circumstances the plan of grazing the root-crop in the field is found to answer because very few sheep are fattened off, but most of the sheep which are wintered are kept in store condition as ewes or ewe tegs. If fattening sheep are made to gnaw their roots they should be allowed the first run in the pens so that they may feed easily, after which the ewes or other store sheep should be made to clear up. The roots should be hacked up as soon as the fattening sheep are moved on, otherwise the shells or cups of the roots will be trodden in in wet weather, and so lost. When sheep are on roots care should be taken that the ground is fed evenly, so that there is an even distribution of manure. The corn and root troughs should be frequently moved. If the weather is wet, a good fall-back should be allowed: that is, the back hurdles should be left for some distance behind so that the sheep will not be cooped in on a small space, but will be able to draw back and select a drier lair. It is better for the land that this should be done, as it prevents puddling, the effects of which are very difficult to overcome when preparing the spring seed-beds.

Turnips given in enclosures or sheds should be sliced, as also should cabbages. Cut clover-chaff and hay may also be used with advantage, and should be fed with the cake or corn. The sheep-cribs and racks in common use are too well known to require description. Whatever system of management may be adopted by the farmer, whether at home or in the field, he ought on no account to withhold salt from his sheep; for not only does a moderate continual use of that article contribute to the digestion of succulent vegetables, and, of course, preserve the animals in constant health, but it is also considered to improve both the



quantity and the quality of the wool. It ought particularly to be used in those situations that are liable to produce liver-rot, of which malady it is a preventive.

We shall conclude this chapter by a few supplementary notes on pasturing, folding, and sheltering sheep.

In "pasturing" sheep it is a good plan, as with all other stock indeed, to change the "bite," that is, to shift them from one field to another; the difference in the herbage giving that change which is found beneficial to all stock. Besides, sheep do best on fresh young grass; therefore, pastures should not be allowed to get rank, but should be grazed down regularly to prevent patchy feeding. When the "bite" is poor, which is of course usually the case in autumn and winter, the feed is supplemented by turnips, oil-cake, hay, and other foods. The turnips are carted on to the field and spread as uniformly as possible over the surface of a certain part or strip, so that the sheep will manure the land as evenly as can be effected. The turnips are generally cut or sliced into "fingers" by a hand barrow turnip-slicer, or by a slicer attached to the cart. The hay is placed in racks—the best kind are on wheels—and the oil-cake and other foods in receptacles, made either in these racks or preferably in specially constructed appliances.

The importance of the provision of shelter for sheep is now commonly recognised. It is true that sheep, unlike other animals of the farm, are provided with heavy fleeces, through which the cold and frost cannot penetrate; but still there is the fact that cold has an effect even upon sheep, and that while it reduces the benefit done to the animals by abundance of food, it influences also in a prejudicial form their health, through the action of the atmosphere charged often with damp as well as cold. Taking the most favourable view as to the capability of sheep—even of breeds provided by nature with the best protection against cold—it is somewhat difficult to see how, if the indications of science be correct as to the influence of cold upon all live stock, a sheep more than other animals can escape its prejudicial effects. If other animals of the farm lose much of the benefits of the food they get by exposure to cold and wet, it cannot be argued that sheep wholly escape this loss.

But apart from the reasons given for providing sheep with shelter sheds in winter, there is another which can scarcely be refuted on any ground. This is the injury done to the fleece of the animals by exposing them to all weathers. Alternations of damp and dry, of rain, frost, and snow, have a bad effect upon the staple of the wool. This, indeed, is admitted by all who have studied the subject. Another source of deterioration of the fleece is the practice of folding on turnip fields, whereby the fleece comes in contact with the wet soil upon which the animals lie.

On the other hand, the farmer has to consider sheep as manure-makers and manure-distributors; and, again, the less cost of feeding the crops on the land where they are grown. Taking all things into consideration, the farmer finds that it is most profitable to keep the sheep in the open, except at special times, such as the lambing season; then, however, he finds the sheep are liable to contract foot-rot, and is glad

to get them in the open pens again. At one time it seemed probable that housing sheep would become somewhat general, but the practice has almost entirely died out, except for show sheep.

If it is deemed necessary to provide protection against inclement weather, there is the advantage that shelter sheds do not involve large expenditure, either of time, trouble, or cost. The most simple form of structure will suffice.

A common and convenient mode of providing temporary shelter is by means of "stuffed" hurdles, *i.e.*, two hurdles fastened together with some two or three inches of straw firmly packed between them. These provide effectual shelter when arranged with judgment, and have the advantage of being easily portable, so that they can be moved on with the fold. "Thatched" hurdles, and common hurdles, covered with waterproof paper or roofing felt, are equally available.

A lean-to hurdle against a side wall or fence will sometimes be the best plan, and at other times a lean-to hurdle on both sides of a hurdle set erect in the open field may be tried. A third plan is to set up two or more rows of vertical hurdles, the rows four or five feet apart, and to lay other hurdles horizontally on the top of them, to form a roof. On sheep farms, a permanent fold for working in at sorting times—shearing, weaning, drafting, marking, &c.—is an absolute necessity, and such an erection is a great convenience even on arable farms where sheep are kept. In the absence of a regular sheep-fold, movable hurdles have to do duty when the flock or any portion of it has been penned; but in such cases it is seldom that more than one, or at the most two, small pens are formed, and this accommodation is very inadequate for handling more than a score or two of sheep.

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## CHAPTER IV.

### THE SHEARING OF SHEEP.

**T**HE shearing of sheep is an object of very considerable importance in rural economy. The time should be determined according to the temperature, and the weather generally. Fat tegs are shorn at any time during spring, as they are often found to sell better than when in the wool. The shearing of ewes is frequently done before the lambs are weaned, so that if any udders are distended or gargety they can be easily detected and attended to. If it is hot, the month of June may be fixed upon, though some breeders defer it until the middle of July, under the impression that an additional half-pound of wool in every fleece may be obtained in consequence of the heat of the weather, and the increased perspiration of the sheep. An early shearing, however, is preferable, where the weather and other circumstances will admit of

it. The new wool will have more time to *get ahead* before the next winter approaches, and the animal, being more thoroughly covered, will be better protected from the midsummer sun. Nature, however, herself points out the proper time for sheep-shearing, and that is, when the old wool has sufficiently separated from the skin, and the new fleece is beginning to grow. The choice of time should not, therefore, depend entirely on the weather, but the farmer should be guided by the rise or growth of the new coat, which the shears cut in separating the fleece.

Of late years there has been much controversy as to the advantages and disadvantages of washing sheep, and though some strong arguments have been brought forward in favour of not washing, farmers as a rule prefer to adhere to the common practice of washing. Accordingly, a week or so before the sheep are required for shearing they are washed. If they are not allowed a full week they may not be sufficiently dried, and, worse still, the yolk may not have risen, without which the wool will be harsh, and there will be considerable loss of weight. The washing is usually performed in some neighbouring stream, or even in a pond, by men standing in the water, who often take cold and occasionally have become seriously indisposed in consequence of the immersion. To remedy this inconvenience, and also the abuses resulting from the careless manner in which the washers frequently do their work, it has been humanely proposed to form a kind of passage through the water between a double rail. The sheep walk into this by means of a slope cut in the bank at one end, and come out by means of another at the other end, with a depth sufficient for them to swim at one part. The breadth need not be more than 6 or 7 feet. At opposite sides of this passage, where the depth is just sufficient for the water to flow over the sheep's back, may be placed two casks, either fixed or loaded, and a man may stand dry in each of them. The sheep being in the water between them, as it swims through the deep part, is seized first by one and then by the other, and thoroughly washed. It then escapes up the other slope into a clean pen, or a dry pasture, or rick-yard, where it remains for a few days, until it is thoroughly dry, and fit for the shearers. Regularly constructed sheep-washing tanks, &c., have long been used on many farms.

The lambs are first separated from the other sheep, and confined in distinct pens. A few planks will form a bridge to the tubs, and there should be a pen at the first mouth of the water, where the sheep may be soaking a few minutes before he is driven to the washers. There is, however, generally speaking, no necessity for all this preparation. The sheep is caught by a man on shore, and thrown into the arms of the first washer, who performs his part, and then hands the animal over to another, from whom, the cleansing being deemed completed, the animal escapes and eagerly swims ashore.

In *washing the sheep*, the use of water containing chalk should be avoided; for this substance decomposes the *yolk* of the wool, which is an animal soap, and the natural defence of the fleece. Wool often washed in calcareous water becomes rough and brittle. The yolk is exceedingly useful to the sheep in cold and wet seasons by the resist-

ance which its oily nature opposes to the rain, while it promotes the growth of the wool, and also imparts to it a greater degree of softness.

The *clipping*, or *shearing*, of sheep is performed in three ways, and a barn, or a small shady paddock, is chosen as the scene of operation. The first and most ancient way is longitudinally from head to tail; but this mode of operating is attended with considerable difficulty, and is not always well executed. The second, and improved method consists in cutting circularly round the body of the animal, the beauty of which is by this means supposed to be increased, while the work is more uniformly and closely executed. The shearer holds the animal under him, either with his knee, or left arm, and clips the wool with a spring-shear, which he is enabled to manage with one hand, and thus to perform the operation without assistance. The entire fleece is removed, without any separation of the different parts of it, and rolled up, and the different qualities are afterwards sorted by the wool-stapler; but previously to the sheep being handed over to the shearer it is a good practice to clip off all coarse and *kempey* wool from the hips, legs, poll, and forehead, and keep it apart from the rest of the wool. This is particularly necessary to be observed in the shearing of lambs: for, in lambs' wool, if the coarse parts and kemps are suffered to mix with the fine, they never can be sorted out, and must spoil any fabric to which the wool may subsequently be applied, because the kemps will not take a dye. Great care should be taken, in shearing, not to give the wool a second cut, which would materially injure and waste the fleece.

The third method is by the use of clipping machines driven by steam or other motive power than hand.

More than one machine for this purpose has been introduced, and found to answer well. The comparatively small flocks in England do not necessitate any such means, but in Australia and the Argentine, where manual labour is scarcer and flocks are larger, mechanical shearing has been successfully adopted. By means of the Burgon shearer (fig. 134) a 12-stone sheep may be shorn in 5 minutes, the work being thoroughly done with regard to neatness and freedom from injury to the sheep and wool. An oil-engine of 2-horse power is sufficient to keep the machine going. The overhead driving gear actuates a core passing inside a flexible tube or shield, and is connected with the shears or cutters, which are on the principle of the horse-clipper, and can be worked at any angle that may be convenient. Messrs. Burgon & Ball, Malm Bridge, Sheffield, are the makers. Another sheep-shearing machine—a pedal power sheep shearer and horse clipper combined with grinder—is that of the Barton-Gillette Horse Clipping and Sheep Shearing Company Limited, 103, New Oxford Street, London. At the Royal Agricultural Society's Show at Maidstone, in 1899, a silver medal was awarded to it "for improvements in pedal power sheep shearing machine, comprising counter balances and ball bearings in shears."

When shorn, the fleece should be carefully folded and rolled, beginning at the hinder part, and folding in the side, or belly-wool, as the

rolling proceeds. When arrived at the shoulders, the wool of the fore part should be rolled back to meet the other, instead of having the binder twisted thence in the usual manner, and the whole secured by a pack-cord in the common way in which parcels are tied. Thus the fleece is kept much tighter together, and unfolds itself with more regularity under the hand of the sorter, who is otherwise much inconvenienced by the confusion or breaking of those parts of the fleece which, in the common method, are twisted together for the band.

The idea of getting more than one wool crop in the year has long since been abandoned.

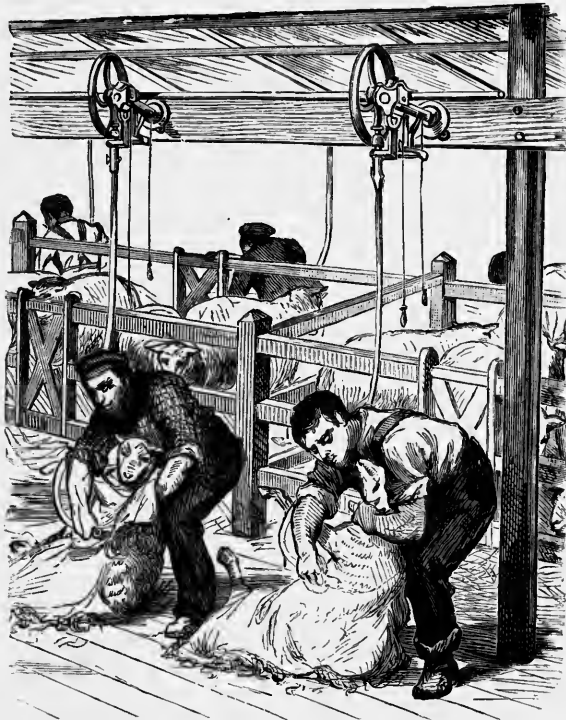


Fig. 134.—Burgon & Ball's Sheep-Shearing Machine.

Lambs are in the South of England occasionally clipped a short time after the rest of the flock: but they are not as a rule shorn until the second year. The wool of the *hoggets* thus acquires a great length of staple, or, a *longer nip*. It is chiefly used in the manufacture of shawls; it commands a higher price than the other qualities, and is of great importance to the proprietors of short-woolled flocks. After sheep have been clipped, it is usual to *mark* them with ochre, raddle, or other colouring matter; but, as it is sometimes difficult to wash the stains of these substances out of the wool, a composition of finely-pulverized charcoal, or

lampblack, and tallow mixed together over a moderate fire, with a small portion of tar to give it a proper consistence, will answer the purpose better. Wool that has been marked with this mixture may easily be cleansed by washing in strong soapsuds.

It is essential that a distinctive mark should be given to the ewe and wether lambs, which is easily done by notching one ear of either of them. The same method may be employed, with some variation, to class them at the future stages of their growth. Where a pure as well as a mixed breed of sheep is reared on the same farm, it will become necessary, in order to avoid mistakes, to distinguish those of the first breed with a mark different from that employed for the sheep of the second. This system might be carried still further, and each sheep branded on the cheek with a separate number; a judicious breeder would then find it conducive to his interest to keep a register, in which the number of each sheep might be entered, and where also such observations as relate to the coupling and crossing of the breeds, and the experiments he may wish to try upon the animals, should be recorded. A careful breeder, who is solicitous to improve his flocks, will, in such register, notice the defects or other qualities of his sheep, their respective states of health or disease, the nature of their wool, the profit they yield, &c. It will thus be easy to ascertain what individuals it is proper to dispose of each year, as well as those from which it will be advantageous to breed; and at length the object proposed will be obtained, namely, the improvement of the different breeds, and their cultivation to the greatest profit.

Of late years the custom has arisen—especially among pure-bred flocks—of marking the sheep with an ear-punch, or by inserting a tag or stud in the ear with a number stamped upon it. A still more recent mode is that of tattooing the ear with distinctive numbers or initials. The great extension of the practice of keeping both private and public registers of flocks has tended to encourage the adoption of better and more effective systems of marking sheep.

## BOOK THE FIFTH.

ON THE BREEDING, REARING, AND FATTENING OF SWINE.

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### CHAPTER I.

#### AN INTRODUCTORY AND COMPARATIVE VIEW OF THE DIFFERENT BREEDS OF SWINE.

IN but few matters connected with stock-breeding has there been a greater change than in the "points" required in a good hog. Some forty or fifty years since "a small muzzle, a narrow forehead and large cheeks" formed the ideal head of a pig. Now, exactly the reverse is required, a broad forehead and small cheeks being necessities in a good hog. In years gone by, fineness of bone, delicacy of skin, sparcity of hair, and neatness of form were indispensable in the improved pig. At the present time, the introduction of the new style of curing, and the resultant large increase in the consumption of hams and bacon, together with the demand for lean in lieu of fat meat, have caused pig-breeders and feeders to seek for pigs of quick growth, of early maturity, and carrying a large proportion of lean meat on lengthy, deep frames, well covered with straight silky hair. The complete change in the style of pig generally required in all parts of the country has led to a diminished inquiry for most of the smaller and fatter varieties of pigs on the part of farmers and others who breed pigs mainly for profit. Nevertheless, we still find, on the home farms of some of our landed proprietors, small herds of the once fashionable, neat and compact pig, which retains many of the points of the Chinese and Neapolitan pigs imported into this country well nigh a century since.

The offering of prizes for pigs at our agricultural shows has resulted in the different important varieties of swine being bred more closely to those points which are looked upon as the peculiarities of each distinct breed. At various times during the last forty years, certain local varieties have, by the extent to which they were bred, or by the influence of some one or more persons interested, received recognition as a pure breed, and separate classes have been provided for them

at the large shows. It will prove a satisfactory way of dealing with the subject, if we give a short description of those varieties for which at the present time the Royal Agricultural Society of England offers prizes. In the Society's prize schedule we find the Large White, the Middle White, the Berkshire, the Tamworth, the Large Black, and the Lincolnshire Curly-Coated breeds.

The Large, Middle and Small White pigs were originally included in the term "Yorkshires," mainly because large numbers of pigs, principally of a white colour, were kept in that extensive county by the farmers, and to a very considerable degree by the mechanics in the neighbourhood



Fig. 135.—Large White Boar, "Holywell Czech II."

Winner of many Prizes. Bred by Mr. Sanders Spencer, and owned by Mr. Charles Spencer, Holywell, St. Ives.

of the larger towns, at some of which agricultural shows have been held for a great number of years. Indeed, the town of Otley claims to have one of the oldest societies extant. It is only within the last forty years or so that any particular attention has been paid to the sub-divisions into which the white pigs are now generally separated, and it is only fair that it should be recorded that breeders of white pigs not resident in the boundaries of Yorkshire have contributed most largely to that fixity of points aimed at in the three sections of what used in olden times to be called the Yorkshire breed of pigs.

The large Yorkshire, or, as it is now more generally called, the LARGE WHITE (fig. 135), should have a white skin, although a few spots of blue on the skin were not specially disliked until foreign buyers objected to it as a sign of impurity. It is not always so, as many of the most successful show pigs have had these blue spots, which, however, are now being care-



fully bred out. The head should be of fair length, light in the jowls, and wide between the eyes; the neck long, but not coarse; shoulders light, and ribs deep and well sprung; loin wide and level, not slack; quarters long and deep; tail set high; arms and second thighs muscular; legs straight and set well outside the carcass; and the whole body covered with silky and straight hair, this denoting quality and lean meat.

The MIDDLE WHITE (fig. 136) is on a smaller scale, shorter in the head, thicker in the body, and with more hair. Sows of this breed are equally prolific with those of the Large White breed, and their produce mature somewhat earlier. Hence they are more in demand for breeding London porkers.

The pigs of the SMALL WHITE breed are much smaller than the Middle Whites, their heads and legs being very short, and their jowls heavy.

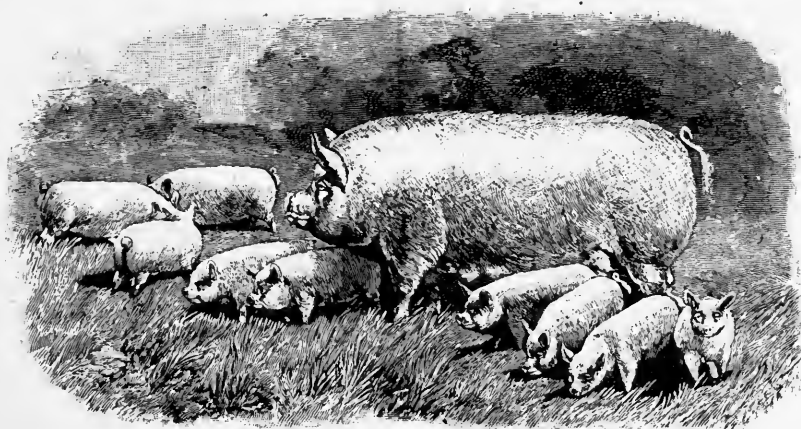


Fig. 136.—Middle White Sow, "Holywell Beauty and Litter."

Bred by Mr. Sanders Spencer, Holywell Manor, St. Ives, Hunts.

Their carcass is thick, and rather deficient in lean meat, and they are covered with a profusion of silky hair. These pigs were considered very handsome.

At an early date after its evolution from the black and white and sandy spotted pig of the midland counties, the BERKSHIRE (fig. 137) became a prime favourite with breeders of improved stock, both in our own and in foreign countries. It was hardy, prolific, and stylish, and furnished a splendid carcass of pork. But the attempt to breed it to the show-yard form, and colour of black, with the feet, the tip of the tail, and the mark down the face white, led to some breeders seeking either a cross with the Small Black, or breeding only from those specimens which more nearly approached the form of pigs of the latter breed. The head was shortened, the jowls became heavier, the shoulders thicker, the legs shorter, and the bone finer, whilst there was increased aptitude to lay on fat. Unfortunately, these breeders were only too

successful in their attempts, and this at the very time when the public taste was beginning to demand pork, bacon, and hams of a leaner description. Some of our leading bacon-curers took energetic steps to bring this question fairly before the breeders of Berkshire pigs, and great benefit has already resulted. There may remain some lost ground to be recovered, although we do not for one moment doubt that the same energy and skill which the breeders of Berkshires have displayed in bringing their favourites to the high standard of form and type demanded by the public, or perhaps by the show-yard judges, will be successfully and quickly applied in producing a Berkshire to meet the present requirements of curers and consumers.

The Large Black Pig (p. 536) has of late years come prominently before the public, and has a Herd-book Society of its own. Some care will be necessary on the part of the managers of this Society since there are at



Fig. 137.—Berkshire Boar, "Baron Kitchener."

Winner of many Prizes. The foundation of the Herd of the Dowager-Duchess of Devonshire, Eastbourne.

least two distinct types amongst the pigs of this breed, one which is chiefly found in the South-west of England being of a somewhat thicker and stronger type of pig than the lengthy, deep sided, if rather lighter fleshed pig more generally cultivated in East Anglia. The sources of origin may account for this variation in character to a slight extent, but the style and size of the fat pig most in demand in the various districts is probably the chief controlling cause.

In the eastern counties the demand is for a pig of good length, with a large proportion of lean, and one which will mature early. The miners in Cornwall may prefer their pork fatter, and from a more matured pig. The sows of this breed are prolific, suckle freely, and are good, quiet mothers. Large numbers of the sows are now being kept in the eastern

counties for the breeding of cross-bred pigs which are fattened before they reach eight months of age, and are sold to the bacon-curers, who report very favourably of them. The boar used is generally a long compact Large White when bacon pigs are sought, and a Middle White boar if the London porker trade is in view. The chief points which the breeders of Large Blacks are now particularly attempting to alter are the slight tendency to coarseness of bone, shortness of back, and the bad shape of the hind-quarters and the hams.

The TAMWORTH breed of pigs has been fortunate in obtaining several doughty champions during the last few years, and its praises have been sung both at home and abroad. The breeders of the red-skinned and long-nosed Tamworth (fig. 138) may fairly claim for it antiquity, as we believe it is one of the oldest of our breeds of pigs. It is known to have



*Photo by*

*W. E. Bird.*

**Fig. 138.—Tamworth Boar, "Director of Whitacre."**

First at the Bath and West and Royal Counties Shows, 1907.

The property of Mr. D. W. Philip, Whitacre, Birmingham.

been very common in some of the midland counties at the beginning of the present century, although its colour was then of a deeper red, almost approaching to a grisly black, especially as the pigs attained maturity. An attempt is being made to eliminate the dark spots on the skin, and also to breed the Tamworth of a much lighter colour. By selection and a judicious cross an improvement will doubtless be secured, whilst the objectionable long snout will be shortened and early maturity encouraged.

Although the Small White pig has ceased to find a place in the prize schedule of the Royal and other Societies, the number of breeds of white pigs is still three, since the admirers of the so-called Lincolnshire White Curly-Coated pigs have formed a Society to look after its interests. The farmers in Lincolnshire have taken up the matter in their usual whole-hearted manner, as though they were determined to give this

thick-fleshed and hardy local pig an opportunity to prove its value. It is claimed for it that it is a refined type of the coarse, strong-boned, coarse-haired pig common in years gone by in the Lincolnshire, Norfolk, and Cambridgeshire Fens. No record appears to be available as to the general system of improvement: it may possibly have been due to the infusion of Large White blood and the continued selection of the breeding pigs possessing the greatest amount of style and quality. In these respects there may be still some room for improvement before pigs of the breed will be able to compete on equal terms with some other older breeds for the purpose of improving the general breed of pigs in other districts or countries; but there is no denying the fact that for the county of Lincoln with its system of farming and the in-boarding of a considerable proportion of the horsemen, shepherds, and stockmen, the Lincolnshire White Curly-Coated is wonderfully well adapted.

There are many local breeds which are held in high repute in the several districts in which they are bred, such as the Black and White spotted pigs which are found in considerable numbers in Northamptonshire, Leicestershire, and Oxfordshire, and which have been called after the last-named county. These pigs are very hardy and fairly prolific, and are much liked by the agricultural labourers and cottagers to consume the garden and house waste during the summer, and then to be fattened in the autumn on the corn gleaned in the harvest fields.

The Improved Dorset was a small-sized black pig, long in the head, with a short thick carcass, and fine, pink skin, sparsely covered with black hair. The Dorset matured very quickly, and furnished as great a proportion of meat from a given quantity of corn as any other breed, but the pork was somewhat deficient in lean meat.

In some portions of Sussex and Wiltshire is found a black pig much longer and larger than the Dorset. Its breeders claim that it is hardy, prolific, and of quick growth. We have seen some very good bacon-pigs from sows of this breed crossed with a Berkshire, or with a Large White boar. The cross-breeds are shorter on the legs, and better sprung in the ribs, whilst the pork has a greater proportion of lean meat.

The Cambridgeshire pigs were until recently of great size, with slouch ears covering their eyes, curly hair, coarse bone, and general want of quality. Many of them have been much improved in quality and early maturity by a cross with the Large White, without losing that robust and prolific character for which they have been noted.

Others of the local breeds, such as the Norfolk, the Leicestershire, the Cheshire, have been so greatly altered and improved by crossing, principally with the Large and Middle Whites, as to lose much of their distinctive character. The change has also to a marked extent been brought about by the demand for young fat pigs weighing from 150 to 250 lb., instead of those monsters weighing 600 to 700 lb. which were by no means uncommon some twenty years since.

The Somersetshire breed (p. 537) is said to be the next suppliant for fame and a herd-book all to itself. It is a pig of a well-defined type, to

which it has bred more or less for a number of years, and, further, it is spoken very highly of for growth and prolificacy by its admirers. It is of a large size, its colour being blue and white, or frequently covering a broad band round the body, which has given rise to its being called a sheeted pig. In years gone by, pigs of a very similar character and colour were found in the counties of Cambs. and Essex, whilst at the present time a breed now known as the Hampshire, and previously as the Thin-rined, breed is found in the United States, and boasts of a herd-book. The Somersetshire pig is of very much the same practical character as the Large Black and the Lincolnshire White Curly-Coated pig, and it requires improvement in the same respects—quality of bone and flesh. If the breeders of Somersetshires and Large Blacks do not allow local jealousies to intervene, but give their best energies to render their pigs still more suitable to supply the best pork markets, and also retain their thrift, hardihood, and quick growth, there appears to be every chance of a market being found for their stock beyond the local borders.

The Welsh pigs are chiefly white, and very much of the razor-backed, coarse-haired, slowly maturing kind, unprofitable alike to the feeder and the consumer. It is a matter of surprise that the Welsh, who are most provident people, should not have discovered that their pigs were capable of great improvement with a little outlay. Well-bred pigs are now so generally raised in many parts of England that no difficulty should exist in procuring young boars at a reasonable price.

Pigs are by no means favourites with Scotchmen,<sup>1</sup> yet considerable steps have recently been taken to improve the Scotch pigs, most of which are white, and very similar in character to those found in Cumberland and the other northern counties, in some of which splendid bacon and hams are produced on the old style of curing.

Ireland has long been noted for the excellence of its bacon and hams, but of late years the large curers have complained very much of the form and quality of the fat pigs sent to the fairs from many districts. The old-fashioned Irish pig was a gaunt long-legged animal which generally had to find its own living until the owner fancied he had sufficient food to fatten it, though this was by no means an easy process. In some of the better cared-for districts pigs were imported from England, and very great improvement resulted from the use of the old-fashioned long-bodied Berkshire, or spotted boar, but after the English Berkshires had been improved the beneficial effects of the cross were not so noticeable. Steps were afterwards taken by some of the Irish bacon-curers to introduce Large White boars, and here again the experiment was not wholly a success, owing to the young boars being bought from English herds where the winning of prizes in the show-yards was the great aim, rather than the production of a pig which would furnish a carcass of pork of the greatest value on

<sup>1</sup> In 1907 the pigs of the United Kingdom numbered 3,966,824, of which 2,257,136 belonged to England, 232,996 to Wales, 146,634 to Scotland, 1,316,729 to Ireland, and the balance to the small islands.

the market. Many of the young boars were too heavy in the jowls and thick in the shoulders, the least valuable portions of the pig; and too light in the middle and hind parts, which realise nearly as much again when cured and exposed for sale. A society was formed by bacon-curers for the improvement of the Irish pigs, and much good will result from it providing its managers do not form too high an opinion of their own stock, and thus fail to look further afield for the boars intended for distribution in the various districts where pig breeding is followed. The very keen competition to which the Irish bacon-curers are now exposed from Canada, and from Denmark and other foreign countries, has doubtless led them to take similar steps to those adopted by the foreign curers, who are constantly importing some of the best Large White boars it is possible to buy, until as good bacon pigs are to be found abroad as in England, and better than the average Irish pig.

It is quite possible that we have omitted to notice some local breeds

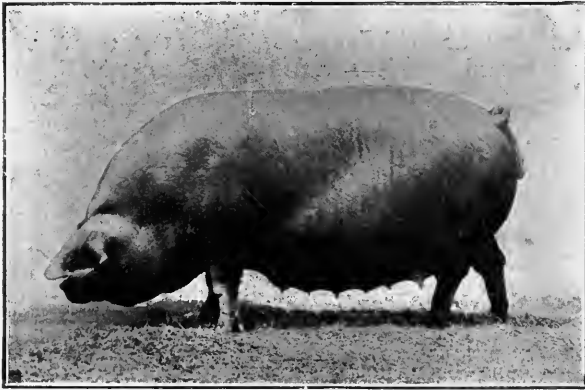


Fig. 138b.—Large Black Sow, "Hasketon Long Lady."

The property of Mr. C. F. Marriner, Thorpe Hall, Hasketon, Suffolk.

of pigs which may have a great reputation in the limited districts where they are bred, but it will usually be found that these so-called breeds are offshoots of one or other of the foregoing varieties.

When an association was established some few years since, mainly by the efforts of Lord Moreton, the late Mr. James Howard, and Mr. Sanders Spencer, for the purpose of registering the pedigrees of pigs and for the general improvement of the chief varieties, the Honorary Secretary, Mr. Spencer, at the desire of the Council, drew up a scale of points. This scale was adopted and embodied in the introduction to the first volume of the Herd-book, and has so generally been accepted as a standard that we have thought it advisable to give it.

The following scale is applicable, as nearly as a single scale can be, to most of the improved breeds:—

	Points.
Head wide and deep, lower jaw sprung . . . . .	10
Neck muscular and rather long . . . . .	5

	Points.
Shoulders wide but not open . . . . .	10
Fore-legs straight and placed well outside the body . . . . .	7
Ribs well sprung and deep . . . . .	12
Loin wide, not slack . . . . .	8
Flanks deep and full . . . . .	7
Quarters long and straight from hip to tail . . . . .	13
Hams wide, with meat down to the hocks . . . . .	10
Hind legs placed well outside and not too much under the body . . . . .	5
Bone flat and not coarse . . . . .	6
Hair long and silky, but without mane or bristles along the neck and shoulders . . . . .	7
	1007

To the above description Mr. Spencer added:—

**BERKSHIRES.—**

- Colour black, except feet and top of tail, which should be white, and with white blaze or mark down the face.
- Fair quantity of hair of fine quality, and not curly.
- Skin thin, without rucks or lines.



**Fig. 138c.—Somersetshire Sow, “Compton Daily Bread.”**

The property of the Dowager-Duchess of Devonshire, Eastbourne.

**LARGE BLACKS.—**

- Colour black.
- Jowl heavier, ears longer and larger, and hanging over the face.
- Shoulders heavier, and hams shorter.
- In other respects like Large Whites.

**LARGE WHITES.—**

- Colour white, occasionally with blue spots on the skin, but without black hair.
- Head rather long, wide between the ears, which should be inclined forward.
- Size, if accompanied with quality, of great importance.

**MIDDLE WHITES.—**

- Colour as above.
- Head short, and ears pricked.
- Body generally more compact, on shorter legs.
- Hair abundant and silky.

**TAMWORTHS.—**

- Colour red, with occasional dark spots on the skin; but these are not considered desirable.
- Other points as near as possible approaching the general standard.

## CHAPTER II.

## ON THE BREEDING AND REARING OF PIGS.

IN the selection of the brood sow there are certain points which must be sought for, and if possible, obtained. Amongst these are a quiet disposition, length of carcass, length and width of hind quarters, at least twelve (if fourteen or fifteen so much the better) teats, placed at regular distances, and commencing as near as possible to the fore legs. The teats should be equal in size, and all capable of supplying milk, as in some strains of pigs many small teats are found as well as many teats of the kind which do not stand out prominently. When the young pigs attempt to suck the latter they recede, and so will not furnish milk. These are therefore called blind teats, and are a source of great loss. Moreover,—and this is of consequence,—this failing is hereditary. It is advisable to obtain the breeding sows from prolific strains, or from a breeder who has paid attention for a length of time to this most important quality in his sows, as well as to their milking properties. As to the question of the purity of breed of the sow there is considerable difference of opinion, some very practical pig-breeders being strongly in favour of a cross-bred sow, whilst others as strongly maintain that a pure-bred sow is, in the end, the more profitable. To the latter opinion we are inclined to lean, provided the sow is obtained from a stock which has not been bred solely for the purpose of winning prizes at our shows, but rather from one where utility and winning points have jointly been the aim.

The boar should most certainly be of a pure breed, and obtained from a stock such as we have recommended the beginner to visit for the purpose of obtaining his sows. Gentle disposition, light shoulders, well-sprung ribs, deep carcass, muscular development, and masculine character should be sought. A well formed and not too large boar is generally a greater success for stock-getting purposes than one overgrown and loosely made.

In the case of pure-bred pigs it is generally best to mate them when they are about eight months old, and then if the young sow produces a large litter and suckles herself somewhat low in condition, she may be given a month's rest, or a little extra food, and the pigs may be allowed to remain on her until they are ten weeks old. This will often be of great advantage to both the sow and her litter, especially if the pigs are farrowed in the latter part of the summer. It will depend to a certain extent on the district, and the system of farming in vogue, as to the best time of the year for the little pigs to arrive. As a rule, it will be found most advantageous to mate the sow in November, so that the spring litter may arrive in February, or early



in March, and thus allow the second litter to come in August, so that the suckers are strong before the autumn sets in. Sixteen weeks, or one hundred and twelve days, is the normal period for a sow to carry her young. It will sometimes be found that old sows, and yelts with their first litters, will farrow before, and that strong lusty sows, with their second or third litter, will go beyond, the expiration of this period.

In the latter case the teeth of the little pigs will be found of an abnormal growth, and sometimes of a dark colour at the roots. This is described by old pigmen as "the pigs having black teeth," and consequently being useless for rearing purposes. So strongly do some old-fashioned people believe in this that they will declare that they never reared any pigs which had black teeth at their birth. They ought, however, also to add that they never adopted the simple and effectual plan of breaking off these extra long and sharp teeth, which the sucker uses with so much vigour when fighting for its favourite teat, whilst, in the attempt, it bites the tender udders of the sow, causing her intense pain. This she at last resents, and, jumping up, with the aid of her nose knocks the youngsters all over the sty. The process is repeated until at last the sow, worn out with fighting, simplifies matters by lying flat on her body and refusing to let the pigs suck. The pigs are soon starved, whilst the sow's udder becomes flushed with milk and inflamed, and quickly arrives at the state termed by old pigmen "caked." If the pig's teeth have been neglected, and the sow, in consequence, suffers as described, the udder must be bathed with warm water, and if possible, some of the milk drawn from it. A little cooling medicine must also be given in warm slop; failing some of the usual pig medicine, 1 ounce of sulphur and  $\frac{1}{4}$  ounce of nitre will be found effectual, this being followed, if necessary, in a few hours by 2 ounces of Glauber's salts (sulphate of soda) dissolved in her drink.

In very cold weather, and often in the autumn, the little pigs will lose their tails if no steps are taken to prevent it. This loss usually commences when the pigs are four or five days old. The tail becomes red, and a scab forms on it about half an inch from its junction with the body. Many and varied are the *certain* nostrums recommended, amongst others, the application of nitrate of silver, cutting a little piece off the end of the tail, picking off the scab, thereby causing the tail to bleed, the application of olive oil, &c. As a matter of fact, we have never found anything so effectual as the use of Barff's Boro-glyceride. If this be applied as soon as the redness of the tail is apparent, and the application continued twice a day as long as necessary, no bob-tailed pigs will be found on the place. Some people have a strong objection to a pig which has lost its tail, and were they judging at a show they would decline to give a prize to such a pig, even if it were otherwise the best. In this there appears to be much prejudice, since the state of the atmosphere at the time the youngster arrived on the scene is far more responsible for the loss of tail than any hereditary

weakness. We should, indeed, not hesitate for a moment in breeding from a bob-tailed boar or sow, provided the other points were such as we look for in a well-developed pig.

Those pigs not required for stock purposes should be operated upon when they are about six weeks old. It is particularly necessary that the sow pigs should be dieted before being spayed, and for a day or two afterwards. A great proportion of the losses sustained from the operation are due to the neglect of this precaution. In some of the litters of pigs there may be found one or more boar pigs with an enlarged scrotum, or, as it is commonly called, "ruptured." These may without danger be operated upon, provided the operator carefully sews up the one incision made for the purpose of drawing the testicles.

**PIG RINGING.**—In the olden times when "rail splitters" were far more general amongst the pigs of this country, it was considered to be necessary to insert into the snout of the pig something which should have the effect of making the animal most careful as to where it poked its nose. In some cases large, complicated, barbarous instruments of torture were—with great pain to the animal—secured in the long snout of the pig, which was rendered very tame by the operation, and also made to fight shy of everything which might by any possibility come in contact with its fearfully sore and tender snout. In this, as in most other matters connected with pig-keeping, a great improvement is visible; the owners and the pigs themselves are more amenable to reason. The former found it to their pecuniary advantage to minister to the wants of the greatly improved pig, which in its turn shows a stronger disposition to rest and be thankful for the more liberal supply of food. A very common kind of pig ring is a horse-shoe nail. The point is made quite sharp, then forced through from the upper to the front portion of the snout and the projecting part twisted round on itself. But in this, as in many other details connected with the mechanical section of the operations on the farm, our American friends have improved on the old system. The plan they adopt is simple, and at the same time humane and usually efficacious. The ring is formed of about  $1\frac{1}{2}$  inches of copper wire, the ends of which are so cut that when it is pressed, by the aid of a pair of nippers suited for the purpose, through the cartilage at the top of the snout, the ends so lap over as to form a complete ring. If one of these rings is affixed on either side of the ridge of the snout, rooting will not be a source of pleasure to the pig, nor will the snout be made sore as is often the case with other rings. In the early autumn after a long drought, the sows will turn up the soft turf in search of roots, notwithstanding the American rings in their snouts. A certain way to prevent this is to remove a small portion of the cartilage on the upper part of the snout. This is effected by the end of a punch specially made.

As to the names applied to swine, the terms yelt, yilt, gilt, gelt, hilt, elt, ilt, &c., are simply local words used to designate a young sow left for breeding purposes. A male pig is called a boar, or a boar pig, and an

aged boar emasculated is termed a *stag*. A female pig is a yelt until she has farrowed, then she is supposed to be a sow. Little pigs of either sex when castrated are called stores, bonhams, bonnaves, &c.

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## CHAPTER III.

### ON THE FEEDING AND FATTENING OF SWINE.

NOW that the system of marketing fat pigs before they are eight months old is becoming very general, it is more than ever necessary to keep the young pigs in a fresh and gradually thriving condition. Indeed, the very valuable advice given by an old shepherd to a young farmer as to one of the chief points in successful sheep-rearing, viz., "Never let them lose their lamb-fat," might in the case of pigs be advantageously altered to "Never let them lose their early fat." In other words, let the fattening process begin whilst the little pigs are on the sow, and continue to feed them so that they never become poor. It is much cheaper to retain this baby-flesh than to renew it when the pig attains the age of five or six months, at which time it should be half fattened. For some fourteen weeks after the sow has been mated she should have as much liberty as possible, so that her progeny may come healthy and strong. In the summer she will not require much beyond a grass-field to wander in, and a little swill, or a few beans, or soaked maize, but it will be advisable to give her some extra food during the month previous to her farrowing. It is also a good plan to let her lie in the place she will occupy when she farrows. She will thus become used to the surroundings, and accustomed to the attendant who may be called upon in difficult cases of farrowing to assist her. Unless the sow is very quiet, it is better to leave her to herself whilst she is farrowing, as the presence of a person, especially of a stranger, often causes the sow to become excited and restless, when the newly-born pigs are apt to suffer from the sow's attempts to rise.

We are aware that in the best-managed herds of pure-bred pigs an attendant is with the farrowing sow, and the little pigs as they arrive are wiped dry with a cloth, placed to the teat for a minute or so, and then put into a hamper partially filled with dry wheat straw, where they usually remain until the act of parturition is completed, the afterbirth being removed as soon as it has left the sow. She is then fed with some warm slop, the little pigs are put to her, and the lot are left until feeding time comes round again.

It is a good plan to walk the sow outside the sty for a few yards on the day after she has pigged. This will nearly always cause her

to relieve the bowels and the bladder, and an attack of constipation and inflammation may thus be avoided. In ordinary cases no medicine is required, and, even if it is, only a very mild dose should be given in the food of the sow. We generally give 2 ounces of sulphur and one-sixth ounce of nitre; a stronger dose than this often causes diarrhoea in the little pigs. This very troublesome complaint generally attacks the pigs when they are three to four weeks old, or just about the time the suckers begin to feed. It is attributed to indigestion, or inability of the little pigs to digest the food on which the sow is fed. A gentle dose of medicine given to the sow as soon as the fæces of the little pigs become unduly hard, or assume a resemblance to peas, will often ward off the attack, which first shows itself in the form of constipation. It is also advisable to reduce the quantity of the food given to the sow for a day or two. We have found much benefit derived from placing earth within the reach of the sow and her young; they will devour well nigh a shovelful of mould every few days. Coal, or cinders, or hard wood ashes, should also be given to pigs of all ages which are confined in sties, whilst a lump of rock salt will soon disappear where a large number of pigs have ready access to it, and the pigs will be greatly benefited.

For the food of the suckling sow and her pigs, until the latter are ten weeks old, nothing is better than sharps, or, as it is variously called, fourths, ran-dan, hogsmeal, &c., with a very little broad bran added. The little pigs may be weaned when they are from six to eight weeks old; in the autumn and winter they are best left with their dam for the longer period. As soon as the youngsters begin to feed they will highly appreciate a little skim-milk if placed within their reach, but it must be so placed that the sow cannot obtain access to it. This may be increased for a time after the pigs are weaned.

When the pigs are about ten weeks old a little meal may be added to the sharps, and this may be gradually increased until at five months old the pigs' food consists mainly of meal, at which time six weeks' or two months' liberal feeding should render the pig quite fit to kill, at a weight of some eight scores or 160 lb. of the finest pork possible, and of the highest market value. If the pigs are of a really good strain, and are fed on suitable food, they will readily give an increase of 1 lb. of meat for each 5 lb. of meal consumed. We, of course, assume that the sties in which the pigs are kept are fairly warm and free from draughts, and that no abnormally cold spells of weather intervene. Until within the last few years theorists were strongly in favour of cooking or steaming the pigs' food, and they asserted that the pigs would then consume a larger quantity of food, assimilate it more completely, and give a greater proportionate return. Some few of our practical pig-feeders did not hesitate to give expression to an exactly diverse opinion on these points, and this view has been proved to be correct. Experiments have been carefully carried out in various parts of North America which have decisively proved that the cooking or steaming of meal or corn given to the fattening pigs had exactly the opposite

effect to that claimed by the advocates of cooking. The pigs fed on cooked food actually ate a smaller quantity of food, and yielded a lower rate of increase from a given quantity of food, than did those fed on uncooked food.

We would strongly advise pig-breeders to mix their pigs' food twelve hours before use, and with warm water during frosty or very cold weather, and, if it be the practice to use maize meal for the very little pigs, it is a good plan to scald this meal, as the young pigs are unable to thoroughly digest the hard and flinty particles which are sure to be present, however careful the miller may be in the grinding process.

Some feeders of pigs still continue the old-fashioned plan of allowing their pigs to wander about on the stubbles for weeks after harvest, and so to run off the little flesh they may have acquired in the summer. Then, about Michaelmas, they are put up to fatten, stuffed with barley meal for a month or two, and placed on the market when it is already swamped with large supplies of pork. Yet, in many instances, these same pigs might have been fed off at far less expense during July and August when the weather was warmer, and the consequent return from the food greater, and the price of pork considerably higher. These two important points are too frequently overlooked, whilst their bearing on profitable pig-feeding is far greater than it used to be in former times, since our bacon-curers are now able to carry on their business as well in the hot as during the cooler months of the year. In defence of the practice of running the stubbles it may, however, no doubt be urged that the pig is a scavenger, and that, while on the stubbles, the animal is developing frame which can afterwards be filled in when the pig is brought into the yard. The procedure to be followed must be determined according to the object for which pigs are kept, but there is little doubt that the most profitable fat pigs are those which have never experienced a so-called store period.

Again, in those districts where summer dairying, or cheese making, is practised, a profitable return may be obtained from the consumption of the whey and of the skim- and butter-milk; many old pig-keepers declare that it is well-nigh impossible to rear a really first-rate lot of young pigs without the aid of skim-milk. By giving the pigs a certain proportion of green clover, lucerne, or tares, or even grass, in the summer, and in the winter hay, chaff, and roots such as swedes, kohlrabi, mangel, and potatoes (the latter steamed or boiled), great benefit is derived. Some persons have recommended the use of cabbages, but we have found them to cause constipation and roughness of the skin in the pigs fed on them to any great extent.

Almost any kind of stuff may be used for the bedding of pigs,—coarse dried grass, dead leaves, carpenters' shavings, sawdust, moss litter, sea sand, as well as straw of all kinds. For the sucking pigs, however, wheat straw is absolutely necessary, as barley straw appears to render the pigs more susceptible to a greasy discoloration of the skin, and to the attacks of lice. The latter crab-like pests are easily destroyed by the use of neat's foot oil; this should be applied with an

old brush on those parts of the pig's body where the lice most do congregate, viz., on the neck, at the back of the ears, or along the back. A second application will be needed in about a fortnight afterwards to kill the produce of the nits which were not affected by the oil.

The exploded idea that a site or building unsuitable for anything else was quite good enough for a pigs' sty has been productive of much harm, as no young animal suffers more from a want of sun, light, and air, than does a sucking pig. The sties should be roomy, well ventilated, free from draughts, and facing south if possible, but certainly not to the north or east. With pigs, as with every kind of stock, constant attention, frequent feeding with only just as much food as the animals will eat, and care in selecting the breeding animals, are bound to prove sources of satisfaction and profit to the owner.

# BOOK THE SIXTH.

## ON THE DISEASES OF LIVE STOCK.

### CHAPTER I.

#### ON THE DISEASES OF CATTLE.

THE rational treatment of the diseases of animals is much facilitated by a knowledge of the structure of the animal body, and of the functions of the various organs in a state of health. In other words, some acquaintance with anatomy and physiology should precede the study of pathology. In recognition of this principle certain details of the kind referred to have been given in Chapter II. of Book the Third (pages 397 to 417). It may be useful at the outset to mention that the termination *itis*, which is frequently used in the names of disorders, is from a Greek word meaning *inflammation*.

FOOT AND MOUTH DISEASE, OR EPIZOOTIC APHTHA.—Introduced into this country in 1839, epizootic aphtha had since that time been constantly with us until 1886, when it altogether disappeared, to be re-introduced by foreign cattle in 1892.<sup>1</sup>

It is a specific eruptive fever, of which most of our farm animals are receptive, and under favourable conditions it is likewise transmissible to man. The virus is thrown off from the body in the discharges from the feet and mouth, and from vesicles which form in the udder. Its vitality is very considerable, in consequence of which it continues to retain its infectious properties for some time after leaving the sick animal. It is this which renders it so mischievous in favouring the spread of the disease by hay, straw, manure, animal and personal intercourse and other means. Hares, rabbits, dogs, cats, and other creatures are no doubt in some instances bearers of the contagion from place to place. Its access or entrance to the body may be through the lungs by the respired air, through the mouth by the food, or through an open wound. The period of incubation varies from two to five days, and then symptoms of ill-health appear.

*Symptoms.*—Slight dulness, shivering, a “staring” coat, and rise of

<sup>1</sup> Only occasional and limited outbreaks of foot and mouth disease, quickly stamped out, have occurred in Great Britain since 1894 and none in Ireland since 1884. The latest occurred in Scotland early in 1908, introduced, it is believed, in hay from the Continent of Europe. It was speedily stamped out.

body temperature are usually the first signs of the disease. These are soon followed by a peculiar sucking noise from the mouth, and a discharge of ropy saliva; or it may be that this is preceded by a restless condition of the feet, which are shifted from time to time, and sometimes shaken, as if to dislodge some offending matter. Blisters now appear in the heels along the line of junction between hair and hoof, or in the cleft of the foot, and similar formations occur in the mouth. These soon break and leave behind superficial sores. In milch cows an eruption sometimes appears on the udder and the teats. In this, as in many other specific diseases, the bowels are constipated, and there is more or less prostration and fever.

In pigs and sheep the general symptoms are much the same as in the ox. In the former, however, the eruption mostly appears on the snout and the feet, whilst in the latter the feet as a rule are alone affected.

*Treatment.*—Foot and mouth disease seldom proves fatal, except to young animals sucking affected dams. In the great majority of cases care in feeding and nursing is all that is needed to bring about recovery.

The affected animal should be placed in a sheltered position and protected from cold and wet. Food should be of the most tempting description, and of the best. A little scalded corn and bran, with sweet well-soaked chaff and a handful of malt meal, forms a most suitable aliment, but where it is not taken to, as is sometimes the case, any other sweet and wholesome food may be substituted.

As a rule, but little medicine is called for. Two or three drachms of nitrate of potash in the drinking water given twice daily will usually suffice to keep the fever in check. If the bowels are constipated a slight aperient may be given, but the routine practice of giving purgatives is much to be condemned. Every step in the treatment of the disease should aim at strengthening the system, that it may throw off the virus and help on to a speedy convalescence.

When fever runs high or complications threaten, such cases demand special treatment, and should be placed under the care of a veterinary surgeon.

The ulcerated feet require to be protected from dirt. Healing of the wounds may be brought about and the virus given off from them rendered inert by the daily application of a solution of alum, carbolic acid, or sulphate of copper. It is seldom the mouth requires to be interfered with, the uniform warmth and moisture it affords being highly favourable to healing of the wounds. If the breath becomes offensive and the ulcers do not readily heal, the mouth may be washed out twice a day with a solution of chlorate of potash, but otherwise there is no necessity for interference.

**CONTAGIOUS PLEURO-PNEUMONIA.**—Like foot and mouth disease pleuro-pneumonia is a specific contagious fever. Introduced into this country in 1842, it has continued from that time to ravage our herds, and the loss it has inflicted on the country may be estimated at many millions sterling. Until recently legislation for its extermination has



been vexatious and abortive. Since, however, the adoption of a rational system of sanitary police, the disease has become exterminated.<sup>1</sup>

Pleuro-pneumonia is believed to be due to an almost invisible organism,<sup>2</sup> which enters the body of its victim through the breathing organs and acts directly upon the lungs. To be effectual it requires that healthy animals shall be brought into contact or near proximity with the sick, so that the virus may pass directly from one to the other. As the contagion quickly perishes after leaving the lungs of the patient, the spread of the disease by straw, hay, manure, and other means such as ordinarily carry it is rendered abortive.

The period of incubation is not a fixed one, but varies in different cases between three weeks and probably as many months. As a rule the shorter term may be accepted.

*Symptoms.*—The symptoms of the disease vary in intensity according to the severity of the attack. In some instances they are very trifling and do not amount to more than slight rise of temperature, unthrifty appearance of the coat, shivering, with impaired appetite, and in milch cows some diminution in the secretion of milk. In the more severe cases these signs of ill health are aggravated, and in addition the breathing becomes more frequent than normal, and ultimately hurried and difficult. The animal coughs at first, only now and then, but as the lungs become more and more involved, this symptom is frequently repeated. In severe cases a deep grunt accompanies the breathing with each expiration, and may be provoked by movement, or by pressing the side of the chest in the space between the ribs. If the ear be applied to the affected side a rubbing sound may be heard. The pulse is quick, full, and at first firm to the touch, but afterwards becomes small and weak. The appetite falls away. At first the bowels are constipated, but this gives way to diarrhoea, with foul-smelling evacuations.

The animal now stands with the head poked out, the mouth wide open and the tongue protruded. The respiration becomes laboured and gasping, and the patient succumbs to suffocation and a vitiated condition of the blood, which the spoilt lungs have failed to purify and correct. Notwithstanding our familiarity with the symptoms exhibited in this disease, it is seldom that even the most expert veterinarian is able to positively assert its existence without a post-mortem examination. Pleuro-pneumonia arising from cold and other accidental causes, some forms of heart disease, tuberculosis, and parasitic affections of the lungs all occasion similar manifestations. The rate of mortality in this disease is very considerable, but recent experience has shown that many cases recover from it. When this occurs a portion of the diseased lung is usually destroyed, and from it infection may be given out for months, though the animal itself appears healthy.

*Treatment.*—The law provides that all animals affected with the disease, and such others as have been in contact with them, shall be destroyed.

<sup>1</sup> Up to the spring of 1908 no outbreak of pleuro-pneumonia had occurred in Great Britain since January 1898, or in Ireland since September 1892.

<sup>2</sup> See "The Microbe of Pleuro-Pneumonia," by Professor M'Fadyean. *Journal of the Royal Agricultural Society*, 3rd series, vol. ix., 1898, p. 388.

**TYMPANY, "HOVEN," OR "BLOWN."**—The condition commonly termed "hoven" is due to the distention of the rumen or paunch with gas, the result of fermentation going on in the food. It is a common ailment among oxen and, although giving rise to serious symptoms, it is on the whole a most tractable disorder, and seldom ends fatally where timely measures of treatment are adopted.

The causes of this affection refer for the most part to the condition of the food consumed and the manner of ingestion. Clovers rapidly grown, when succulent and full of moisture, and especially if taken when the morning dew is on them, prove a fruitful cause of the disease. Rank luxuriant herbage of any kind has a tendency to ferment and give off offending gases. Stale grains and unripe potatoes when taken in excess are often responsible for attacks of hoven, and particularly when hurriedly consumed after a long fast. Sudden change from dry to green succulent food will account for many cases seen in the spring of the year, when cattle are leaving the yards for the open pasture. It has elsewhere been noticed that "hoven" accompanies choking. In this condition, rumination being suspended, decomposition takes place in the food owing to its long retention in the rumen while under the influence of heat and moisture, and the stomach becomes inflated with gas as the result.

This affection occasionally assumes a chronic character as the result of organic disease of the stomach, whereby the digestive function is disordered. In young beasts balls of hair lodged in the rumen have been known to produce it by interfering with rumination.

*Symptoms.*—The symptoms of hoven are very characteristic. The abdomen becomes much enlarged. This is shown more particularly in the left flank, where the walls of the belly are elastic to the feel, and when struck emit a drum-like sound. Gas is frequently discharged by the mouth as sour smelling eructations, and the bowels are irritable and expel their contents in small quantities. The breathing will be embarrassed in proportion to the degree of distention existing in the stomach, and some pain may be evidenced by grinding the teeth, striking the belly, and grunting.

*Treatment.*—In a case of this kind there are two objects to be achieved—

1. To remove the gas already existing.
2. To prevent its further accumulation.

The first of these is to be effected either by puncturing the rumen with an instrument devised for the purpose, comprising a trocar or spear, and a cannula or tube, or by the administration of suitable medicines.

If the first course be adopted, the animal is placed in a stall and the operator standing on the left side forces the instrument into the flank four or five inches from the spine and midway between the last rib and the haunch bone. The paunch lies immediately beneath this part. When the trocar has entered the paunch it is withdrawn, while the cannula or tube is left behind to allow the gas to escape. As fresh gas will continue to be generated, the cannula should be allowed to remain

in the stomach for an hour or more if necessary. With regard to medicine it is desirable to give a saline aperient, such as a pound of Epsom salts, to which may be added two or three ounces of the aromatic spirits of ammonia and an ounce of powdered ginger. This should be followed in two hours by a draught consisting of three ounces of aromatic spirits of ammonia in three pints of water. When the gas has been removed a table-spoonful of chloride of lime may be given in two pints of water in order to prevent further decomposition. No food should be allowed for the first 12 hours after relief has been afforded, but linseed gruel may be given plentifully.

**IMPACTION OF THE RUMEN, OR "MAW BOUND."**—The disease just treated of had reference to the distension of the paunch with gas. In the disease commonly termed "maw bound" or "grain sick," now to be considered, the first compartment of the stomach is filled to repletion with solid food. The result of this surcharge of the organ is to occasion paralysis of its walls and an inability to expel its contents.

*Symptoms.*—Impaction of the rumen is made known by an enlargement of the abdomen, but in this case the drum-like sound and elasticity of the belly which we referred to in speaking of "hoven" are absent. Pressure applied to the swollen flank causes instead a pitting as if made on a piece of dough. The affected animal is dull, and wears a heavy expression of the face. The pulse is full and quick; the breathing is increased in frequency owing to forward pressure on the lungs; with the continuance of the disorder symptoms of pain appear, and the animal becomes restless, grunts, and grinds its teeth, or the brain sympathising with the engorged stomach suffers functional derangement. This is marked by extreme dulness, a tendency to sleep, or, it may be, by great excitement and frenzy, when the animal displays symptoms characteristic of madness.

*Treatment.*—The bowels, which in cases of this nature are constipated, require to be freely opened by the administration of a bold aperient. Sixteen to twenty ounces of sulphate of magnesia (Epsom salts), with four drachms of aloes and two ounces of tincture of gentian, in two quarts of warm linseed gruel, should be given at once, and if in 12 hours there is no response half the quantities may be administered in the same measure of gruel. If, in addition to the distended stomach, the animal becomes "blown," a table-spoonful of chloride of lime given in a quart of cold water will prove serviceable by checking fermentation of the imprisoned food. A little walking exercise is desirable where the patient is able to take it, and friction to the belly by means of a rough brush, or the application of turpentine and oil, will prove of service in guarding against gastric inflammation.

**IMPACTION OF THE OMASUM, "FARDEL BOUND," OR "CLUE BOUND."**—The third compartment of the stomach of the ox is termed the omasum or maniples, and, like the first division or rumen, it is liable to become over-distended with food. Sometimes this overfulness, if not removed, leads on to inflammation, when it is termed "omasitis," and in other

instances the brain gives evidence of derangement when it is described as "vertigo" or "staggers."

Impaction of the omasum is mostly seen in cattle which are living largely or exclusively on coarse, dry, and indigestible food, and especially where the herd is insufficiently supplied with water. The old dry herbage left for autumn feed will sometimes induce the disorder. This is often found to be the case where, as in parks, it becomes mixed with the fallen leaves of trees, the husks and fruits of the oak and beech, and other vegetable matters containing astringent or binding principles. Animals consuming large quantities of straw with an insufficient supply of roots and water not infrequently suffer from impaction of this part of the stomach. It is also seen as a complication of other ailments, as lead poisoning and the specific fevers.

*Symptoms.*—The symptoms exhibited in this disorder are not so diagnostic as in those last considered. The bowels are constipated and the feces coated with a slimy mucus; food is refused and rumination ceases. There is a dull pained expression of the face with lowering head. The pulse is hard and frequent, and the animal obstinately stands with no disposition to move, or lies with its head extended on the ground. Grunting, and grinding the teeth, with an occasional glance towards the side, indicate the existence of pain in the abdomen. If relief is not soon afforded the brain may suffer disturbance, when the eyes stare, sight is impaired, and the gait is unsteady and rolling, or the patient may exhibit symptoms of frenzy.

*Treatment.*—Here the constipation of the bowels must be overcome by bold cathartics, such as have already been prescribed in impaction of the rumen. Some practitioners prefer castor oil to Epsom salts in this disease, but it matters little which is selected so long as it is properly administered. When suffering is considerable, an application of mustard or blistering oil may be made over the right side and under surface of the belly. Enemas of warm water should be administered three or four times during the day, and plenty of thin gruel horned into the patient from time to time.

If the brain gives evidence of disturbance, cold water applied to the head by means of a syringe will prove beneficial, and it may be necessary to abstract blood from the jugular vein.

**INFLAMMATION OF THE TONGUE, OR GLOSSITIS.**—The tongue of the ox is liable to become the seat of inflammation which may assume either an acute or chronic character. Cattle are much more subject to this form of disease than horses, and the reason may probably be found in the fact that in the former the tongue is employed as an organ of prehension and is therefore more exposed to injury than in the latter.

Inflammation of the tongue may arise from mechanical injury, or chemical irritation, or result from the stings of wasps or other insects. Rough coarse food and cold frosted grass are said to have the effect of causing inflammatory irritation of this organ. In foot and mouth disease it is also present to a greater or less extent, and, in that

peculiar fungoid disease of the mouth termed "actinomycosis," chronic inflammation of the tongue is rarely absent.

*Symptoms.*—In acute glossitis there is more or less discharge of ropy saliva from the mouth. The tongue is red and swollen, and often protrudes, when it soon becomes of a dark red or reddish blue appearance.

Embarrassment of respiration may result from extension of the swelling towards the throat. At this time the head is extended and the mouth widely opened. Should the disease persist the organ becomes black and cold, and covered with vesicles or blebs. When the malady assumes a chronic form as in "actinomycosis," it is slow in its progress, and the tongue undergoes gradual enlargement. The surface is studded over with small pimples which develop into abscesses, and these into spreading ulcers.

*Treatment.*—As soon as the disease appears a bold dose of aperient medicine should be administered comprising sixteen to twenty ounces of sulphate of magnesia (Epsom salts), with two ounces of powdered aniseed. Should free action of the bowels not be induced in 12 hours a further dose of eight ounces may be given. The tongue will be relieved by puncturing it at several points with a sharp clean lancet and afterwards fomenting it with warm water, or inserting the face in a nose bag containing hot bran. Animals in good condition should be slaughtered if no improvement results within twenty-four hours after the prescribed treatment.

CHOKING is a common accident among cattle, and especially during the period when they are in the yard or the stall. It is almost invariably the result of an impaction of the œsophagus or gullet with food, and especially with portions of turnip or mangel. Sometimes thorns, nails, pieces of stick, and other foreign substances become fixed in the upper part of the throat and interfere with swallowing.

Occasionally the passage of food is interrupted by wart-like growths extending into the gullet. Now and again the same result follows the sudden and spasmodic contraction of the tube, or stricture of the lining membrane.

*Symptoms.*—The symptoms of choking are usually very conspicuous. They vary somewhat, depending upon the position of the impaction. For the most part they comprise frequent attempts to swallow, protrusion of the muzzle, occasional coughing, suspension of the cud, and a discharge of saliva from the mouth. After a time the body becomes enlarged owing to distension of the stomach with gas, and hence arises difficulty of respiration from encroachment of the stomach on the chest.

The seat of the choke may frequently be determined by an examination of the throat and of the course of the neck. The former is effected by passing the hand into the mouth, and carrying it beyond the *root* of the *tongue*. The latter may be done by manipulating the left side of the neck, when the impaction will be recognised as an enlargement in the tract of the gullet. Where the stoppage is situated in the chest it

is, of course, beyond observation. Choking is sometimes attended with attempts at vomition.

*Treatment.*—The measures adopted will of course be directed towards removing the impacted substance. If it is high up in the throat this may be effected by means of the hand passed into the mouth. When found in the course of the neck an attempt should be made to move it upward or downward by careful handling. If it consists of imperfectly masticated hay or straw its removal may sometimes be readily effected in this way, especially after a little water or oil has been poured down the throat. Where these means fail, the probang or “choke rope” must be introduced. In performing this operation the head should be held straight out, and the instrument having been passed as far as the obstruction, gentle and continuous pressure should be kept up. Violent, jerky movements of the instrument are much to be deprecated, as they frequently result in rupture of the œsophagus. Where the animal is much “blown” it may be desirable to puncture the stomach before passing the “rope,” in order to avoid suffocation.

**JAUNDICE OR YELLOWS.**—The term jaundice is applied to various morbid conditions of the liver in which the blood becomes charged with bile, and the skin and tissues of the body are frequently stained of a yellow colour. The blood contamination is the result of some obstruction to the escape of bile from the liver, in consequence of which it is re-absorbed into the blood-stream.

The causes of jaundice are many and varied. The chief among them are congestion of the liver, tumours in and upon the gland, and blocking of the bile ducts with gall-stones, parasites, and other foreign matters. It is also observed in certain contagious diseases, such as anthrax and Texan fever, as well as in septic states of the blood, and in poisoning by lead, copper, mercury, &c.

*Symptoms.*—The leading feature of the disease is a yellow discoloration of the skin and urine. The state of the bowels varies from time to time between obstinate constipation and extreme looseness. The dung is at one time dark in appearance, and at another pale or clay-coloured. It contains a quantity of sticky mucus, and emits an offensive odour. The skin is harsh, dry, and scaly, and the patient presents a dull unthrifty appearance.

*Treatment.*—Where the disease arises from tumours in and upon the liver but little benefit can be hoped for from treatment. As, however, we are seldom aware of the precise cause of the ailment, the malady must be treated on general principles. The objects to be attained are to eliminate the bile from the blood and open the channels of the liver, so that the secretion may flow into the intestines to take its part in the function of digestion. The bowels must be acted upon by aperients. For this purpose sulphate of magnesia (Epsom salts), with the extract of dandelion and a little aloes, will be found useful.

Nitrate of potash, given in the food once daily, will stimulate the kidneys to throw off the surplus bile from the blood; and the tone of

the system may be upheld by such agents as nux vomica in powder, or gentian and columba in the form of a decoction. The diet should be light and easy of digestion. Small quantities of food often repeated are better than full rations. Exercise will prove a valuable adjunct to medicinal treatment.

**RED WATER, BLACK WATER, WOOD EVIL, OR MUIR ILL.**—The disease commonly known as red water is so called from the red or reddish-black appearance presented by the urine. This discoloration is due to the presence of the red colouring matter of the blood, which has escaped from the vessels with the urine in the act of secretion.

The disease is essentially one affecting the blood itself, causing the red corpuscles to break up, and their coloured contents to become mixed with the serum or water in which they are suspended. The immediate cause of the affection until recently was obscure. It is known to prevail mostly in the spring and autumn. Cows recently calved are particularly susceptible to it and suffer most severely. Although some herbs and other members of the vegetable kingdom do occasionally cause illness, accompanied by a dark or red condition of the urine, true red water is due to minute organisms, called "piroplasms," which gain access to the blood, being usually conveyed by means of certain ticks which actually penetrate the red cells of the blood, causing their destruction and escape of colouring matter as already mentioned, this colouring matter being eliminated by the kidneys.

It has been observed that the tendency of an attack is to cause derangement of the liver and to impair digestion, but in what particular way the blood changes are induced cannot at present be precisely stated. It may well be, as has often been stated, that feeding on undrained pasture often leads to the contraction of the disease.

*Symptoms.*—In this disorder there is dulness and great prostration, the movements are feeble and unsteady, the limbs tremble and the muscles twitch. The coat stands on end, and the skin is chilled. The dew is absent from the muzzle, and the mouth is dry and clammy.

Impaired digestion is shown by looseness of the bowels, which is soon followed by constipation. The membrane of the mouth, and that lining the eyelids, are pale and bloodless. Palpitation of the heart is very pronounced in some cases, and dulness may be succeeded by great excitability and even delirium. Urine is frequently and freely discharged. In colour it is sometimes red, at others of the colour of porter. If boiled it becomes thick and muddy, and throws down a dense precipitate of albumen.

*Treatment.*—The affected animals should be housed, and covered with a warm rug or blanket. A dose of Epsom salts, with a little ginger, may then be given to empty the bowels and relieve the oppressed liver. This should be followed by small repeated doses of turpentine, with nitric ether, given in well-boiled linseed-cake gruel. A plentiful supply of strong linseed tea should be allowed, and, if necessary, horned into the patient several times daily. Where the

prostration is considerable the strength will require to be supported by well-boiled milk and eggs. A tempting nutritive diet, such as oatmeal boiled or raw, malt meal, sweet bran or pollard, is necessary to uphold the strength, and with it a little salt and carbonate of potash may be advantageously administered. When the more acute symptoms have subsided the medicines above referred to may be discontinued, and a dose of sulphate of iron administered morning and evening in the food until convalescence is re-established.

INDIGESTION IN CALVES, "WHITE SCOUR," OR "SKIT."—This disease most frequently arises out of a bad system of feeding and of general management, though its direct cause is now attributed to a minute organism, which is spread from one animal to another by means of dirt, decomposing milk, &c. Among the causes predisposing to attacks of the disease may be mentioned, over-crowding, bad ventilation, and want of cleanliness. The practice of allowing manure to accumulate in the calf-house and give off its foul emanations while every outlet is closed, as frequently occurs, is much to be condemned. Stale milk, and milk fed out of dirty pails, will, if persisted in, disorder the function of digestion. Calves which have done a long railway journey, or have been exposed for many hours in the market without food, are very liable to suffer, when allowed an unlimited supply of milk, and especially if that be stale, or if it has been exposed to the atmosphere of a foul dairy or other apartment. Calves transferred from the teat to the pail, if permitted to gulp down the milk greedily, are more liable to suffer than others naturally fed. Too long intervals between feeding are also conducive to indigestion.

Some disorders of the dam so far influence the quality and composition of the milk as to render it hurtful to the calf. Water containing sewage, or largely charged with decomposing organic matter, has this effect in certain cases, and the same may be said of decomposing roots, rank herbage, and sudden changes of food. Long fasting and fatigue also influence the lacteal secretion prejudicially, and render it unwholesome to the offspring. Some calves cannot tolerate the milk of foster mothers, and especially that of old calved cows however wholesome it may appear to be. Fright and excitement also tend to impair the milk, and impart to it irritant properties.

The *Symptoms* of Gastro-enteritis are sometimes sudden in their onset and severe, at others gradual and progressive. The general appearance and behaviour of the little patient undergoes a marked change. The coat loses its lustre, and becomes rough and "staring," there is dulness and loss of appetite and a desire to lie down constantly, the muzzle is dry, and the mouth hot and clammy. The belly is tucked up, and the back arched, but the main feature of the disorder is the repeated discharge of stinking faecal evacuations of a pale yellow colour and sharp pungent odour. At first the motions are fairly consistent, but they soon become semi-fluid, and on examination are found to contain a large amount of mucus as well as firm curdy masses, and sometimes blood. Pain and straining attend their discharge, and a



deep moan or grunt is heard now and again, while the teeth are forcibly ground.

*Treatment.*—Place the affected animal in a clean, warm, well ventilated shed, and clothe the body with a woollen rug. Give an oleaginous purge to remove offending matter from the digestive canal,—one to two ounces of castor oil with a teaspoonful of laudanum will serve the purpose. Then every three hours administer two tablespoonfuls of the following mixture in half a pint of water:—

Prepared chalk one ounce, tincture of catechu one ounce, tincture of opium half an ounce, bi-carbonate of potash a drachm and a half, whisky one ounce, powdered cassia half a drachm. Water sufficient to make up eight ounces.

Medical treatment is of little avail, and it is advisable to aim at prevention.<sup>1</sup>

**DIARRHŒA OR SCOUR.**—Diarrhœa is characterised by the frequent discharge of thin watery dung. It is the result of some irritating influence acting upon the delicate membrane of the bowels, either through the blood or in the food or water ingested. It is, therefore, a symptom of disease affecting the intestinal canal.

The causes which induce it are many and varied. They are chills, drinking large quantities of cold water while heated and fatigued, or sudden changes of diet, especially from dry to rapidly grown, rank herbage, or ill-conditioned roots. Excessive quantities of undecorticated cotton-cake, and irritant and acrid plants also induce it. Diarrhœa is sometimes the result of imperfect mastication and ravenous feeding. It also attends structural disease of the liver, and tubercular affections of the intestines, and may have its origin in water charged with organic and other impurities, particularly when habitually taken in the summer season.

*Symptoms.*—The chief feature of the disease is the frequent and forcible expulsion of fæces. These are usually of a thin watery character and sometimes offensive. They are often mingled with a greater or less amount of thick mucous fluid, the presence of which is shown by the bubbles of gas which it entangles in the excrement. When the disorder is only of a temporary character there is little else to be noticed than looseness of the bowels. In severe and protracted cases, however, the appetite fails, rumination is suspended or only tardily performed, the body consequently shrinks, and there is marked illness. The pulse is quick, small, and weak, the breathing shows slight disturbance, and the visible mucous membranes are pale and bloodless. Impairment of the digestive function is further shown by frequent eructations of gas from the stomach and low rumblings of the abdominal organs. Abdominal pain is mostly present in protracted cases and is expressed by grinding the teeth, restlessness, and an occasional look towards the flank. Where diarrhœa results from organic disease of the liver or lungs, as sometimes occurs, the cause of the disorder is manifested by special symptoms referring to those organs, as well as by the chronic character of the case.

<sup>1</sup> Preventive measures should consist of the free use of disinfectants in cow-house, calving-pens, &c., also the application of disinfectant dressings to the navels of calves immediately after birth and two or three days longer. The internal administration of medicine calculated to destroy or neutralize the virus should be adopted when the disease has made its appearance.

*Treatment.*—In most instances of this ailment the symptoms are due to the lodging in the alimentary canal of some irritant which will require to be got rid of. For this purpose a dose of castor oil or linseed oil may be given in conjunction with a small dose of tincture of opium. Should the flux still continue, astringent and antiseptic medicines must be prescribed, such as a combination of chalk, kino, opium, nutmeg and creosote. Where the disorder is of long duration, and the prostration considerable, brandy or whisky may be added to the prescription. While the attack continues, solid food must be replaced by starch gruel, or a plentiful allowance of linseed tea, to which may be added a little carbonate of soda.

**DYSENTERY OR BLOODY FLUX.**—In this disease the lining membrane of the bowels is the seat of a destructive inflammation resulting in ulceration and sloughing of the tissues of the gut.

It has its origin in various causes, and is sometimes the result of chronic diarrhœa. Water largely polluted with sewage, when taken for long periods and especially in the summer months, has on several occasions been known to produce it, and it is also said to arise out of the ingestion of innutritious provender, decomposing vegetable matter, and certain contagious germs.

*Symptoms.*—Dysentery may assume an acute or chronic form. In the first case it usually comes on suddenly, and is attended with fever and more or less severe abdominal pain. The dung is discharged frequently, and, as in diarrhœa, it is of a semi-fluid or watery character, but in addition to fœcal matters it also contains blood and mucus, with stinking shreds of dead tissue from the diseased bowel. The passage of the fœces is attended with pain and straining. The existing fever is marked by a dry hot skin with “stareing” coat, clammy mouth, dry muzzle, and an increase of the temperature of the body. The appetite is lost, and, unless relief is afforded, emaciation and exhaustion soon end in death. In the chronic form of the disease the symptoms are much the same as those stated, but are more gradual in their development and protracted in their course.

*Treatment.*—It is rarely the case that complete success attends the treatment of dysentery. The ulceration and sloughing of the intestine so far impair the function of digestion as to establish a chronic irritability of the bowel, which tends to emaciate and weaken the patient beyond recovery. At the outset of the disorder a mild dose of castor oil may be administered with a small quantity of tincture of opium. This should be followed every eight hours by a draught containing carbolic acid, glycerine, and catechu, to which a further quantity of opium may be added if abdominal pain is considerable. The food should consist of the most nutritive and digestible material. Scalded oatmeal, boiled carrots or turnips, boiled linseed, malt meal and cake gruel are among the best forms of aliment. If the emaciation is considerable, a little sound beer or whisky may be administered with the gruel three times a day. A clean well-ventilated stable is much to be desired in cases of this description.

**MILK FEVER OR DROPPING AFTER CALVING.**—Milk fever, or, as it is technically termed, “parturient apoplexy,” is not really a “fever,” there being no rise of temperature in uncomplicated cases. Indeed, in some cases the temperature is actually below normal. It is rather of an apoplectic character, the blood-vessels of the brain or spinal cord being in most cases more or less congested, this in many cases resulting in some paralysis and loss of consciousness.

*Symptoms.*—The disease generally appears from twelve to thirty-six hours after calving. The first signs of illness are: cessation of rumination, arrest of milk-secretion, dulness, and lowering head. This is followed by paddling with the hind feet, and a rolling unsteady gait. Then succeed staggering and paralysis, as a result of which the animal falls helplessly to the ground. The head is now turned towards the flank and rests on the side. The eyes are half-closed and the animal cannot be roused. The pulse is quickened, and the breathing heavy. Sometimes the belly becomes enlarged by gaseous distension of the paunch, and there is an inability to swallow.

The actual cause of “milk fever” is not known. It appears to have now been proved conclusively that the disease is not due to a parasitic organism, as was at one time thought to be the case.

*Treatment.*—The old-time methods of treatment, by bleeding, purging, and the administration of stimulants, with external application to the back and loins of irritating liniments, have now given place to the injection into the udder, through the teats, of one or more of the following substances:—A solution of iodide of potassium,<sup>1</sup> solution of chinisol, oxygen gas, atmospheric air (either sterilised or not), peroxide of hydrogen, or even pure water warmed to the body temperature. Afterwards the udder is gently kneaded. The patient is made as comfortable as possible, and propped up into a natural recumbent position by means of trusses of straw or bags stuffed with chaff.

**ABORTION OR SLINKING.**—For practical purposes, abortion may be said to occur when an animal fails to carry her young through the full period of pregnancy.

The causes of abortion are very numerous. Many cases result from external violence, such as blows and kicks. Others are induced by fright, foul odours, poisonous plants such as savin and yew, and possibly, ergoted grasses. Over-driving and long fasting conduce largely to the disorder, especially when followed by over-feeding and the ingestion of large quantities of cold water. Violent purgatives and the excessive use of saltpetre, common salt, and other medicaments, are productive of the mishap, and the same may be said of foot and mouth disease, pleuro-pneumonia, tuberculosis, and other specific diseases. The contagious form of abortion is due to minute organisms which invade the womb of pregnant females, where they set up a specific inflammation which results in the death and subsequent expulsion of the foetus.

<sup>1</sup> See *Journal of the Royal Agricultural Society*, 3rd series, vol. x., 1899, p. 154.

*Symptoms.*—As a rule, abortion takes place without any premonitory signs. In other instances the symptoms are those of approaching parturition, filling of the udder, relaxation of the external generative organs, and a slight ropy discharge from the genital outlet.

*Treatment.*—This must be considered under two heads—preventive and remedial.

Preventive treatment of this contagious form of abortion should consist in taking care that a pregnant heifer or cow has no contact either directly or indirectly with an animal that has already aborted; sponging, once each day at least, the vulva and under part of tail of cows that are two months and upwards in calf when a case has already occurred in a herd or on premises near; never allowing a heifer or cow to be served by a bull that has served a cow that has aborted, unless such animals have had disinfectants thoroughly and judiciously applied to the genital organs; taking great care to isolate and disinfect an animal that has aborted from any cause, and continue this until all discharges from the womb have ceased; also being very particular to destroy by burning or otherwise the foetal membranes and discharge-stained litter which have been in contact with such an animal.

When abortion has appeared in a herd the internal administration of an antiseptic such as carbolic acid in small daily doses to all animals that have been pregnant for four months and upwards, in conjunction with the sponging, has beneficial results. Judicious feeding and the observance of the isolation and disinfection recommended above are important. Avoid the out-of-date and absurd method of rubbing mustard on the back, still practised to some extent. It is based on a misconception and is worse than useless.

**RHEUMATISM.**—Rheumatism is a constitutional disorder of a painful character affecting the joints and sinews of the limbs and sometimes also the muscles of the various parts of the body. In severe forms of the disease it attacks the heart and often induces serious and even fatal changes in its structure. The so-called “chine fellon” and “joint fellon” are forms of rheumatism.

The actual cause of rheumatism is not well understood. The circumstances under which it arises are:—1. An inherited predisposition. 2. Exposure to cold and wet while the system is in a heated condition; in this connection easterly and north-easterly winds are very productive of it. 3. An impairment of the composition of the blood consequent on long continued indigestion. It occasionally follows injury to joints, ligaments, or tendons.

*Symptoms.*—The disease may assume an acute or a chronic form. In the former it comes on suddenly, with fever, loss of appetite, “staring” coat and dry muzzle. The bowels are constipated and the urine high-coloured. Swellings of the joints and sinews appear, first in one limb, then in another, and the disease shifts from place to place and varies in severity from time to time, being one day better, another worse. The inflamed parts are hard or fluctuating, and painful to the

touch, and there is considerable lameness, to relieve which the patient will remain lying for many hours together. In the chronic form of the disease the symptoms are less severe than in the acute, but are of the same character.

*Treatment.*—The bowels should be acted upon by a saline purge at the outset, and the patient confined to a bran diet. Iodide of potassium and carbonate of potash should be given two or three times daily. Should this fail, colchicum may be tried in combination with it. The local applications are to consist of hot fomentations, after which the part is to be well cased in dry flannel bandages. In some cases soap liniment and tincture of opium or belladonna, well rubbed into the skin, will allay pain and disperse the enlargement. The patient should be placed in a dry, well-littered box, free from draught and be disturbed as little as possible.

Should the swelling remain after the pain and lameness have dispersed, a blister once or twice repeated may suffice to remove it.

**MAMMITIS OR GARGET.**—Garget is an inflamed condition of the udder usually occurring during the period of lactation. It is mostly confined to one quarter, but may affect two or more quarters at the same time.

The causes include mechanical injury, such as blows and bruises; overstocking, *i.e.*, allowing the milk to accumulate unduly in the gland to give it a tempting appearance in the market; exposure to cold easterly winds while the body is heated, or to draughts. Garget sometimes arises as a complication of other diseases, as foot and mouth disease and cow-pox, and may also result from indigestion.

*Symptoms.*—Although a local affection, there is in these cases more or less general disturbance, as fever, loss of appetite, and restlessness. The affected quarter is hot and painful to the touch, red and swollen, and the fluid removed from it is mixed with white curdy masses and sometimes with blood or pus. Animals with large bags experience some difficulty in walking owing to the pain which it excites.

*Treatment.*—Give a bold dose of Epsom salts as soon as the trouble is observed, and a milder dose in forty-eight hours. Draw the milk off carefully three or four times a day from all the quarters. Foment the bag well, morning and evening, and suspend it in a sling. This may be done by cutting four holes in a broad piece of flannel for the accommodation of the teats and fastening it over the loins. Bleeding may have to be adopted in some severe cases, and where abscesses form they require to be opened. These are operations which require the aid of the veterinary surgeon.

If after the subsidence of the inflammation the gland remains hard, it should be vigorously rubbed two or three times a day with camphorated oil, to which a little soap liniment may be added.

**ANTHRAX.**—This is a specific contagious disorder affecting, to a greater or less extent, all our domesticated animals, but more frequently young oxen. It is due to the presence of a minute rod-shaped organism in the blood, technically termed *Bacillus anthracis*. The

powers of reproduction of this microbe are such that if but a small number gain entrance into the circulation, in a few hours they are found in hundreds in every drop of blood, not only impairing its properties and reducing its vitality, but blocking up the vessels through which it circulates and bringing about a general stagnation of the vital fluid. It is on this account that the disease proves so rapidly fatal and defies all methods of treatment.

Anthrax prevails to the largest extent in damp situations, especially in the course of river valleys and on low undrained and undrainable marshes and retentive clays, where the germs linger in the soil for long periods, and under the influence of heat and moisture multiply with extraordinary rapidity. It is also frequently seen in beasts confined in sheds and yards, whence the virus is conveyed in drinking-water and articles of food and by various other means. There is reason to believe that the germs of anthrax are sometimes incorporated with the fodder gathered from infected pastures, and retain their vitality and virulent properties for many months. The entrance of the anthrax bacillus into the system is said to take place mainly through wounds and abrasions in the mouth. This may account for young animals being so frequently affected during the eruption of the second dentition, when the gums are broken by the displacement of the temporary teeth.

*Symptoms.*—The onset of this disease is very sudden and it runs its course very rapidly, seldom extending over forty-eight hours and often proving fatal in from six to twelve. The first notification of the existence of anthrax in a herd is frequently the sudden death of one of the number. Others may be seen standing alone, refusing to move or feed, with drooping head and dull expression of face. If the body temperature be taken it is found to be much elevated, the pulse is small, feeble and rapid, and the breathing is more or less accelerated. When moving, the gait is stiff or staggering, the muscles twitch and quiver, and in some instances swellings appear about the throat and neck. Now and again there is a discharge of saliva from the mouth, and the dung is stained with blood, or the urine is also similarly discoloured. The animal obstinately stands until it falls and expires.

*Treatment.*—The treatment of anthrax need not be considered save in so far as it refers to measures of prevention. It is most desirable that the affected beast be at once destroyed.<sup>1</sup> This should be done by the poll-axe, and pithing so as to limit the escape of blood as much as possible, and to prevent the soil and manure of the homestead from becoming further tainted with the virus which the blood contains. The carcass should be removed to waste land, or into a wood or some place to which stock have no means of access, and there buried six feet deep in lime. Before removing a carcass the mouth, nostrils, eyes, and anus, indeed all the natural outlets of the body, should be filled with this substance, in order to absorb the discharges and prevent the scattering of the virus.

<sup>1</sup> A leaflet, "Notes on Anthrax," may be had gratis on application to the Secretary, Royal Agricultural Society, 13, Hanover Square, London, W.

Sheds out of which diseased animals have been moved should be thoroughly cleansed and disinfected and the litter and manure burned. Where the disorder occurs in the pasture the stock should be removed to a yard thinly littered, in which they should remain for a week or ten days or until fresh cases have ceased to occur, when they may be transferred to a fresh pasture. The field in which the disease arose should not be stocked for at least three months or until the cold season, and then only with horses or sheep or aged beasts. A dose of aperient medicine may be given to the entire herd with advantage, and the further treatment should be relegated to an experienced veterinary surgeon.

WARBLES.—These are small rounded swellings of the skin about the size of a hazel nut. They are found along the backs of cattle in large numbers and have a small opening on the summit. Each swelling



Fig. 139.—1. Ox Warble Fly, *Hypoderma bovis*, De Geer.<sup>1</sup> 2. Maggot. 3. Chrysalis.

consists of a grub or larva of the ox warble-fly (fig. 139) buried in the substance of the skin. The egg is deposited on the skin during the months of June, July and August, and the grub (fig. 140) burrows in the hide, remaining there until the following summer when it escapes through the much enlarged orifice (figs. 141 and 142), and falls to the ground, where it remains as a chrysalis, from which the fly eventually

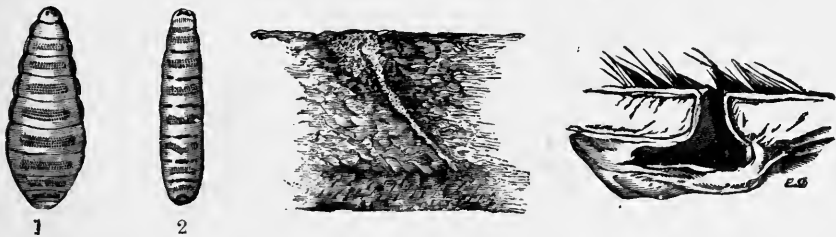


Fig. 140.—Warble Maggots (magnified).  
1. Club-shaped.  
2. Worm-like.

Fig. 141.—Section of Track made by Warble Maggot in Hide (magnified).

Fig. 142.—Section of Warble, after Soaking in Water.

emerges. When existing in large numbers warble-maggots induce a good deal of constitutional disturbance and suffering, and prevent cattle from thriving. In some cases they have been known to cause death by “blood poisoning.” In all cases they seriously damage the quality of the hide for market purposes (figs. 143 and 144).

<sup>1</sup> Since our last edition appeared it has become known that two varieties of the warble fly are common in the United Kingdom, *Hypoderma bovis* being most prevalent in Ireland, and *H. lineata* in England.

Warbles are best disposed of by puncturing the sac in which the grub is contained with a needle moistened with a little mercurial ointment, or the grubs may be squeezed out in the spring-time and destroyed. To prevent cattle being attacked the backs should be lightly smeared over with a solution of oil of tar and assafœtida.

We are indebted to Miss Eleanor A. Ormerod, for the follow-



Fig. 143.—Warbled Hide.

View of under surface (about half size).

ing details:—The *Ox Warble Fly*, or *Bot Fly*, is a two-winged fly, upwards of half an inch in length, so banded and marked with differently-coloured hair as to be not unlike a humble bee. The face is yellowish; the body between the wings yellowish before and black behind: and the abdomen whitish at the base, black in the middle, and orange at the tip. The head is large, the wings are brown, and the legs black or pitchy, with lighter feet. The female is furnished with a long egg-laying tube; but whether she inserts her eggs into the hide, or lays them on it, has not been made out with certainty. Egg-laying takes place *during the summer*; it may begin in the month of May, but the time varies with the weather, with the position of the pastures, and other circumstances. The egg is oval and white, with a small brownish



lump at one end. When full-grown the warble-maggot is of the shape shown in fig. 139.

The mischief may first be found on the flesh side of the hide early in the winter.

Whilst the maggots (fig. 140) are in the warbles, though a skin-like membrane forms round the surface of the perforations (see figs. 141 and 142), they cannot heal up because the maggot lies within; and when the warble-grub has *fallen out*, though the whole contracts, the surfaces, being already covered with a film of tissue, are slow to unite; and, as may be seen in warbled hides (figs. 143 and 144), union is often prevented by this skin-like film shelling off, and lying with dried matter in the perforation. On the under side of the hide, though

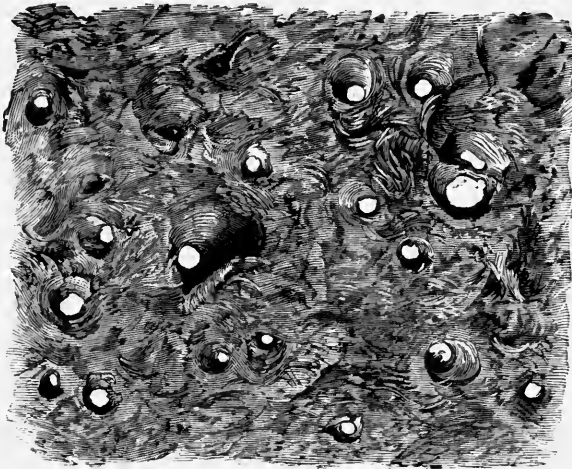


Fig. 144.—Portion of Under Side of Warbled Hide, after being Tanned.

the *surface may not* be broken, yet the subcutaneous tissues are often left as a mere film of no strength, which injures the surface of the leather.

When the maggot is full-grown it is about an inch long and dark grey; it presses itself out of the opening *tail foremost*, and falls to the ground, where it finds some shelter, either in the ground or under a stone or clod, and changes to a chrysalis. The chrysalis is dark brown or black, much like the maggot in shape, only flatter on one side; and from this brown husk the warble-fly comes out in three or four weeks, but this length of time is *increased by cold weather*.

With regard to methods of remedy, there does not appear to be any difficulty of getting rid of the warble-maggot easily and cheaply, when the warble has "*ripened*"—that is, opened so far that the black end of the tail is visible. *Then* it may be destroyed cheaply and quickly. From special observations, taken during the last three years, it has

been found that where the warble maggots have been destroyed before they drop from the cattle, there is little if any summer attack of warble-flies. Consequently the cattle can rest in peace, and, as there is very little egg-laying on them, there are scarcely any warbles in the following spring.

Squeezing out the maggots is a sure method of getting rid of them, and they may be destroyed to a less complete extent by dressing the warble with a little of McDougall's smear or dip, or by a little cart-grease and sulphur, applied well on the opening of the warble. Mercurial ointment answers, if carefully used—that is, in very small quantity, and only applied *once* as a *small* touch on the warble; but where there is any risk of careless application it should not be used. *Any* thick greasy matter that will choke the breathing-pores of the maggot, or poison it by running down into the cell in which it lies and feeds, will answer well; and lard or rancid butter, mixed with a little sulphur, has also been found efficacious. Tar answers if carefully placed, so as to be absolutely on the hole into the warble. Bought cattle are often badly infested, and need attention.

To prevent fly attack in summer, train-oil rubbed along the spine, and a little on the loins and ribs, is said to have been found useful; also the following mixture:—4 oz. flowers of sulphur, 1 gill spirits of tar, 1 quart train-oil; to be mixed well together, and applied once a-week along each side of the spine of the animal. But experiments carried out by the Irish Department of Agriculture have led that authority to the conclusion that none of several dressings tried were effectual in preventing fly attack, while some of them caused the hair of the animals to fall off. We cannot accept this verdict, however, as the final one on the subject. Further trials should be made with various smears, excluding those proved to have had a prejudicial effect upon skin and hair. Still, as the trials extended over three seasons, their declared results should be accepted provisionally, and attention, except by experimenters, should be concentrated upon the certain method of squeezing out the maggots during the winter and spring. There is no doubt that this is the best method of getting rid of the maggots, and of thus preventing the development of numbers of flies. It is just possible, however, that the conflict between English and Irish evidence may be due to the fact that there are two varieties of the warble fly, one prevailing generally in the former country, and the other in the latter.

There are many other points that bear on prevention, including the fact that warble flies are *most active in heat and sunshine*, and appear *not to pursue cattle over water*; consequently, it is desirable to allow the cattle the power of sheltering themselves, and to give them access to shallow pools. Likewise with regard to pastures, or standing-ground of infested cattle, it is a matter of course that where the maggots *have fallen from their backs the flies will shortly appear to start new attacks*.

The attack of warbles is the cause of enormous national loss, estimated by practical men at sums of from *two millions to seven millions pounds sterling per annum*, at the least.

LICE.—These degraded forms of wingless insects (figs. 145 and 146) are found on all our farm stock at one time or another. They prefer the poor and emaciated for their host, although the better fed and conditioned are not exempt from them. Where they are present they induce a good deal of irritation and annoyance, and should be got rid of as quickly as possible.

A decoction of tobacco with a little salt in it applied on the skin,

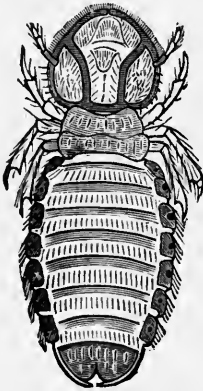


Fig. 145.—Small Biting Ox-Louse,  
*Trichodectes scalaris*.  
(Magnified.)

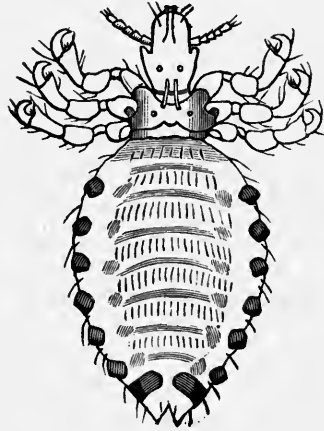


Fig. 146.—Large Sucking Ox-Louse,  
*Haematopinus eurysternus*.  
(Magnified.)

and repeated in a few days, may be sufficient, or should this fail a dressing of whale oil, sulphur, and a little oil of tar may be tried.

To guard against a return of these pests the stable or shed should be thoroughly cleansed and the old litter removed.

RINGWORM is a parasitic disease of the skin to which all farm-stock are more or less liable. It is most frequently seen in calves, especially when they are in a low, dirty, debilitated condition, or when closely packed in small, badly-ventilated sheds, where manure is allowed to accumulate and ferment. It is due to a minute fungus which settles upon the skin, burrows into the cuticle, and passes down into the follicles of the hair, causing the latter to fall off and the skin to throw out a scaly eruption. The seat of the disease varies in different cases, but in calves it is mostly seen about the face and neck. This appears due to the fact of the animals infecting each other, owing to their heads being so frequently in contact one with the other.

*Symptoms.*—The eruption of ringworm occurs in round scurfy patches, which spread in circles, causing the hair to break away and fall off, leaving behind bald places, varying in size from that of a three-penny piece to that of a florin. Sometimes they run together and form large irregular patches; in this way the entire body may become covered with a thick scabby eruption. The irritation caused by the parasite is not severe, but there is, generally, more or less itchiness

and desire to rub the skin. Where such an eruption as that described occurs in a number of calves about the same time the diagnosis of ringworm may be accepted.

*Treatment.*—All the manure should be removed, and the shed swept down and lime-washed, and clean straw supplied in the place of the old litter. The mangers and fittings will require to be well soaked with some disinfectant. Treatment of the skin should be commenced by removing the scurf with soap and water, and afterwards the patches of eruption may be dressed once daily with a solution of corrosive sublimate (two or three grains to an ounce of water) for three or four days in succession; or a little tincture of iodine may be painted over the surface in a like way. Oxide of zinc ointment may be used with advantage. A paper on "Ringworm in Calves," by Sir George Brown, appeared in the Journal of the Royal Agricultural Society, 3rd series, vol. vi., 1893, p. 308.

**RINDERPEST.**—This is a disease which is due to a specific virus. It is always present in the Steppes of Russia, and other parts, from whence it spreads to neighbouring countries, and may, under favourable circumstances, be conveyed to remote districts, as the virus retains its vitality for a long time. Owing, however, to the existing methods of inspection, it is not likely to gain a footing in this country again, so that a description of symptoms is not called for in such a work as this. It is, however, significant that when introduced into any place where it is not indigenous, it always assumes a great amount of virulence and proves very fatal.

**TUBERCULOSIS.**—This is a disease to which all the domesticated animals are susceptible, and is caused by the invasion of one or more of the organs of the body by the tubercle bacillus.

Owing to the very extensive use of cow's milk as a food for children and invalids, tuberculosis in dairy cows assumes special importance in relation to the health of human beings, particularly in cases of *generalised* tuberculosis, or when the udder is the seat of the disease, because in each of these instances tubercular bacilli are often present in the milk drawn from the affected cow, and it is now admitted that human beings, especially children, are capable of becoming affected with tuberculosis by means of the bacilli so derived from the cow, notwithstanding a slight variation of characteristics in the bacilli common to bovines and those of human beings. Tubercle bacilli of fowls, again, differ somewhat from either of the two former kinds, and do not appear to possess the power of transmitting the disease to human beings to any marked extent, except, possibly, under very exceptional and favourable circumstances.

The symptoms of tuberculosis vary, according to the organ chiefly affected; thus, when the lungs is the principal seat of the disease, a cough is the most characteristic symptom, accompanied, as in all cases of advanced tuberculosis, with more or less general wasting of the

muscles, &c. When the glands of the bowels are diseased, diarrhoea is a prominent symptom. Tuberculosis of the udder presents itself as a firm tumour-like area, generally in the upper part of the udder, which has no tendency to suppurate (form matter), but steadily increases in size until a large part of the udder becomes diseased and loses its power of secreting milk. In the early stages the quantity of milk is actually increased, but as the disease advances it becomes less and the quality deteriorates, the milk of the affected quarter has a thin bluish appearance, and eventually quite alters in character, separating into a kind of curds and whey.

Tubercle bacilli are remarkably resistant to changes of temperature and the action of disinfectants. Ingestion seems to be the most common mode of infection, at any rate in the lower animals, and probably in man also.

We cannot enter here into the question of the degree of certainty attaching to the tuberculin test for the detection of the disease.

In further reference to the transmissibility of bovine tuberculosis to man, we take the following extracts from the Annual Report of the Royal Veterinary College for 1907, written by Sir John McFadyean:—

“It will be remembered that in the course of an address delivered at the Congress for the Study of Tuberculosis in London, in July, 1901, Professor Koch renounced the opinion which he had formerly expressed regarding the identity of human and bovine tuberculosis, and openly declared that the question whether man could be infected from cattle was unproved, but that if such transmission ever took place the occurrence was so rare that it was not advisable to take any measures against it.

“The controversy which was then started has been since maintained, but fortunately it appears to be drawing to a close, at least with regard to the main point of dispute. As a result of Koch's pronouncement a Royal Commission was appointed in this country in the autumn of 1901 to investigate the relationship between human and animal tuberculosis, and it has since been continuously engaged with this problem. Simultaneously experiments bearing on the same question have been carried on in Germany, and during the course of the present year both the English and the German Commissions have published exhaustive reports giving the result of their researches to date.

“The general plan of the experiments carried out in the two countries was substantially the same, and, as might have been expected where competent workers were engaged, the results are also in close agreement. The English Royal Commission made a painstaking investigation of sixty cases of tuberculosis occurring in human beings, and came to the conclusion that in fourteen of these the bacilli which caused the disease had been derived from cattle. The German Commission similarly investigated sixty-seven cases of the disease in man, and in eleven of these they found bacilli which were identified by them as bovine bacilli. In two of these eleven cases the patient had been infected both from a human and a bovine source, but in the other nine the lesions contained bovine bacilli only.

“As previously remarked, it was to be expected that, since they followed the same methods of investigation, the English and German Commissions would obtain substantially the same experimental results; but there was, of course, no such certainty that they would draw the same conclusions from these results. As a matter of fact, however, the conclusions are very similar.”

**JOHNE'S DISEASE.**—An until recently obscure and intractable disease affecting young cattle, chiefly between the age of six months and three years, in which the only visible signs are wasting of the flesh and a persistent diarrhœa, due to minute bacteria which infest the intestines. It was almost generally thought to be of a tuberculous character, but the microscope has now revealed its true nature. Unfortunately, however, no reliable treatment has at present been discovered, and the affected animals usually eventually die.

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## CHAPTER II.

### ON THE DISEASES OF HORSES.

**COLD OR CATARRH.**—This disorder is generally induced by exposing a horse to cold or wet, while in a state of perspiration. Its symptoms are dulness and watering of the eyes, cough, discharge from the nostrils, some quickness of breathing, and somewhat accelerated pulse. (A healthy horse's pulse beats from thirty-two to forty strokes in a minute.) A little additional warmth, a few mashes, and a small dose of saltpetre will usually effect a cure; but if the cough is obstinate, and the mouth gets hot and the throat sore, the matter becomes more serious, and the regular practitioner should be called in.

**CHEST AFFECTIONS.**—In all chest affections, such as pleurisy, inflammation of the lungs, and bronchitis, the veterinary surgeon should be promptly consulted. Where an animal shows signs of general illness, with difficulty of breathing and frequent cough, one of these ailments may be suspected, in which case mustard should be applied over the sides and a dose of whisky administered, pending the arrival of the surgeon.

**ROARING AND WHISTLING.**—The terms roaring and whistling are applied to abnormal sound emitted during the act of breathing. They are symptoms of disease affecting the respiratory passages, and more especially that part termed the larynx, or upper extremity of the windpipe (page 410). Whichever form the disease assumes it constitutes unsoundness, and not infrequently leads to complete disablement in consequence of the obstruction which it causes to the passage of air to

and from the lungs. Mares suffer less from the disease than stallions and geldings, and ponies are rarely affected by it. The liability to it increases with the height of the animal. Roaring may depend upon a variety of causes. Some of them are temporary and sooner or later pass away, but the most common cause of the malady—that which is accountable for 95 per cent. of the cases we meet with—is of a chronic and permanent character.

Roaring may arise out of anything which interrupts the flow of air along the air channels. Hence it occurs from tumour in the nostrils, the throat, or the windpipe, or from pressure upon the latter in some part of its course along the neck. The form, however, in which we mostly meet with it is the result of paralysis and wasting of the muscles of the larynx. As a consequence, the cartilages which compose the latter fall in, and reduce the size of the respiratory passage, hence the noise. It is difficult to say how the paralysis is brought about. We know it frequently results from colds, influenza, and strangles, but there are many instances of its on-coming without any obvious disturbing cause. Hunters turned out to “summer,” perfectly free from defect in the breathing apparatus, have returned confirmed roarers. The late Professor Spooner used to refer some cases to the excitement and fear induced by railway journeys. Whatever may be the exciting cause the hereditary nature of the disease is now well established, and mares and stallions who suffer from it should not be used for breeding purposes. Horses of a certain type of conformation would seem to be more liable to it than others. Such are animals with a long neck, long legs, light middle, small sheath, and whose head is set on at right angles with the neck, and especially if these characters are associated with an irritable temperament. The prevailing system of getting young horses up for show purposes, and letting them down again, is a fruitful cause of the disease.

Where roaring arises out of laryngeal paralysis but little benefit is to be expected from treatment. The horse should be kept in good condition by liberal feeding and a fair amount of daily work. The food should consist chiefly of corn, and whatever hay is allowed should be given at night. Long periods of rest and low diet are prejudicial to roarers, and tend to aggravate the malady.

When the disease first appears, iron and strychnia in small repeated doses may be given for a fortnight at a time during two or three months, with an interval of a few days between each period. If the breathing becomes seriously embarrassed, and the services of the animal interfered with, the operation of tracheotomy may be resorted to. This consists in making an artificial opening in the wind-pipe, and introducing a tube into it through which the animal may breathe.

It sometimes occurs that noisy breathing follows upon a cold in consequence of slight thickening of the membrane lining the air passages. Here the application of mustard to the throat every two or three days, and the administration of iodide of potassium in two or three drachm doses, will effect a speedy restoration to health. The operation of opening the throat and taking out the displaced portion

of cartilage from the larynx has been largely practised in this country during the past two years, but the results obtained do not warrant its continuance.

**INFLUENZA OR "PINK EYE."**—This is a specific infectious fever, at all times affecting our studs to a greater or less extent. Periodically it becomes wide-spread and virulent, passing from one part of the country to another with great rapidity, and causing much inconvenience and loss. Horses in large towns where they are closely packed together in ill-ventilated stables suffer most, but those better housed do not always escape.

**Causes.**—The cause of influenza is ill-understood. Various reasons have been assigned for its prevalence, and Professor Williams says "it may occur spontaneously." For a long time it was referred to some peculiar climatic condition, but there is much in its history to warrant us in regarding it as due to some subtle organism which at present awaits identification.

**Symptoms.**—Sudden prostration and premature fatigue are the symptoms to which attention is first directed. This is accompanied by a rise of temperature, dulness, a "staring" coat, and, it may be, some slight shivering. The appetite is lost and the desire for water is increased. Later on the nose discharges a watery or white purulent matter. The eyelids are sometimes swollen, and tears flow from the eyes. There may or may not be sore throat and cough. If fever runs high, the pulse is quick and weak, and the breathing increased in frequency. In some outbreaks of the disease the liver and digestive canal are specially deranged. When this is so the lining membrane of the eyes is of a yellow hue, the mouth is hot, clammy, and foetid, in addition to which the bowels are constipated and the dung is coated over with slimy matter. This form of influenza is known as bilious fever.

**Treatment.**—Place the animal in a large, roomy, well ventilated box or shed. Clothe the body and apply flannel bandages to the legs. Then administer a stimulant, such as whisky, nitric ether, or ammonia, and repeat it every four or six hours according to the severity of the case. The diet should be nutritious, well scalded oats, bran, a little linseed, and malt forming a tempting mixture. Roots or green food, according to the season, form an agreeable cooling diet and may be freely given. If the discharge is profuse, steam the nostrils. Where the throat exhibits soreness by difficulty of swallowing, apply mustard or a poultice of hot bran.

In the bilious form of the disease give four ounces of Epsom salts in warm water and a little ether, and repeat it on the following day. In all forms of the disease the strength should be well supported by stimulants and a light tempting diet. Serious complications frequently arise in the course of an attack of this malady. It is always desirable, therefore, when a speedy change for the better is not effected, to seek the assistance of a qualified veterinary surgeon.

**INDIGESTION** is a common ailment among farm horses where sound



principles of feeding, and judicious apportionment of work, are not carefully observed.

*Causes.*—The causes by which indigestion is induced are many and various. Sometimes they refer to the animal itself, and at others to the nature and quality of the food upon which it subsists. In the first connection we notice it to result from imperfect mastication of the food, either arising out of some deformity of the mouth or irregularity of the teeth, or from soreness of the gums, so frequently seen in young horses while passing through the second dentition. The habit of “bolting” the food, often induced by long fasting, is a fruitful cause of impaired digestion, especially if the supply of water is insufficient, and if it is administered after—instead of before—feeding. Indigestion frequently results from the excessive use of certain kinds of food, such as wheat, unclean corn, new barley, and coarse, hard, or mouldy hay. The too free use of wheat chaff, and of chopped straw, without the corrective influence of roots, is also a fruitful cause of the ailment. Intestinal parasites must be held responsible for many cases of this disorder.

*Symptoms.*—If the teeth or mouth be at fault there may be a discharge of ropy saliva, or foaming at the mouth, while feeding; or the food may be “quidded,” that is, dropped in a half masticated condition into the manger instead of being swallowed. Irregularity of the bowels is shown by constipation alternating with looseness, whilst the presence of whole corn and undigested chaff in the dung, and the discharge of fœtid gases with the latter, are marked indications of alimentary trouble. “Hide bound,” “stareing” coat, scurfy and itchy skin, with loss of condition, are also frequently seen in cases of this kind. Indigestion sometimes occasions chronic cough, at others it is associated with swelling of the legs and with skin eruption.

*Treatment.*—The mouth should first be examined, and any irregularity of the teeth corrected. A dose of physic is sometimes all that is required to restore the digestive function. In other cases, tonics, such as sulphate of iron, or nux vomica and bicarbonate of potash, have the desired effect. Where animals are liable to derangement of the digestive function, special care should be observed in feeding and working. The food requires to be given oftener, and in smaller quantities, than usual. It should not be bulky, but above all sound and good. What hay is allowed should be given at night and not during the working hours. A liberal allowance of bran will serve to maintain a uniform activity of the bowels, especially if during the day a tablespoonful or two of linseed-oil be mixed with it.

**COLIC.**—There are two kinds of colic. One is known as spasmodic, in which the intestine is in a state of morbid contraction, and the other is termed flatulent or “windy colic.” The latter consists of a distension of the gut, or intestine, with gas. Spasmodic colic is by far the more common of the two ailments.

*Causes.*—Colic is mostly the result of indigestion, brought about either by some functional or structural disease of the intestine itself,

or by errors of diet. It is produced by sudden change of food, from dry to green, or from green to dry; by the ingestion of coarse innutritious provender; by overfeeding, especially when the system has been weakened by long fasting. Certain descriptions of food, as new corn, potatoes, and vetches, may give rise to colic. Drinking cold water when the blood is overheated is a most fruitful cause of the disorder, as are also worms, and calculi or stones in the bowels. The various salts of lead and other chemical compounds sometimes induce it.

*Symptoms.*—The commencement of the disorder is usually sudden, and the pain and suffering are paroxysmal, coming on, and, after a short period of agony, disappearing, to return again after a brief interval, this being repeated again and again during one, two, or many hours. The affected animal throws himself down violently, rolls, groans, and quickly rises. He will then walk round the box, looking occasionally towards his flank; he paws the ground, stamps his fore feet, or strikes his belly with the hind feet. Sometimes he moves backwards and presses the quarters against the side of the box. The bowels are usually constipated, but looseness is sometimes present, particularly where the attack is due to a green vegetable diet. A good deal of gas is at times discharged from behind, which brings temporary relief. While the pains are on, the pulse is increased in frequency, and the breathing is quickened, but these disturbances pass away as the pain subsides, only, however, to return with each recurring paroxysm.

In flatulent colic the abdomen, or belly, is greatly enlarged, and when tapped emits a drum-like sound. The pain is much less severe than in the spasmodic variety, but constant. No intervals of ease are observed such as characterise spasmodic colic, and the patient has but little desire to lie down and roll as in the last-named disorder.

*Treatment.*—In these cases an antispasmodic draught, consisting of an ounce and a half of tincture of opium and an ounce of nitric ether, should be promptly administered in a pint of cold water. If in an hour the pain has not disappeared, give four or five drachms of aloes, either in a ball or dissolved in warm water, and repeat the spasmodic mixture every two or three hours if necessary. Walking exercise, to prevent rolling, should be enforced for the first hour, during which enemas may occasionally be given with advantage. Mustard and friction to the belly will be found useful as an adjunct.

**INFLAMMATION OF THE BOWELS OR ENTERITIS.**—None of our adult farm animals are so liable to inflammation of the bowels as the horse, and in none is the disease so rapidly fatal.

*Causes.*—As to its origin, Professor Williams says the only recognisable causes are “over fatigue, cold from exposure, or from washing with very cold water whilst the animal is heated.” To these, however, we would add unrelieved impaction of the bowels, protracted colic, the ingestion of rank succulent herbage, and arsenical and some other forms of poisoning. It may also result from the accidental twisting of the bowels,

and from other disarrangements to which the intestines of the horse are specially liable.

*Symptoms.*—The earliest signs of enteritis are those indicative of abdominal pain, or belly-ache. The animal paws the ground, looks anxiously round toward the flank, strikes the belly, and stamps with the hind limbs. Now and again he lies down carefully, and resumes the upright posture without going through that violent rolling and struggling so characteristic of simple colic. For a time he obstinately stands and then walks round the box. The pain in enteritis is constant, and in this respect differs from colic, in which, as we have already noticed, it comes on in violent paroxysms and then subsides, to return again after a short interval. In the course of the attack cold sweats bedew the body, the face is pinched and haggard, and all food is refused. The pulse is quick and hard, the breathing hurried and sighing, and the mouth hot and sour-smelling, while the bowels are constipated.

*Treatment.*—The treatment of enteritis requires the most careful and well-directed efforts of the experienced veterinarian, and no time should be lost in seeking his aid. Where this cannot be procured immediately, the administration of a dose of opium will afford relief from pain, and the soothing influence of hot flannels upon the belly should not be overlooked. Enemas of warm water may be thrown into the rectum, and the general comfort of the animal ministered to until professional assistance is procured. All food should be withheld, and a plentiful supply of linseed tea provided for the patient to drink whenever he chooses.

Horses having recovered from an attack of this affection require the greatest care in feeding for some time after convalescence is established. The food for a while should be cooked and given in small quantities, and regularity of feeding often needs to be strictly observed.

**FEVER IN THE FEET OR LAMINITIS.**—The disease known as “fever in the feet” is an inflamed state of the vascular tissues of the foot.

*Causes.*—Laminitis is mostly seen in fat heavy horses with flat weak feet, or those having feet of a strong, upright, blocky character. The disease frequently results from over-driving when the roads are hard, or from long standing, as in protracted sea-voyages, or where in certain forms of disease the patient is compelled to stand for long periods. It is also induced by drinking cold water while the body is heated and fatigued, by eating wheat, new barley, and an excess of beans. It not unfrequently attacks mares after foaling, and heavy fat stallions when on the road. Now and again it follows the administration of a dose of physic, but the reason has not been satisfactorily made out. Horses affected with pleurisy and inflammation of the lungs sometimes contract the disorder at a period when they are fast approaching convalescence.

*Symptoms.*—The disease is mostly confined to the two fore limbs, but it may involve all. The posture and gait are the chief indications of inflammation of the feet. When standing, the fore limbs are thrown forward and the hind ones are advanced beneath the belly. In pro-

gression the patient walks on the heels of the affected feet and removes the weight of the body from the front part where the pain is specially felt. If the attack is a severe one there is much constitutional disturbance. This is shown by the high fever, quick hard pulse, hurried breathing, dilated nostrils, and patchy sweats. The severity of the pain may provoke a deep grunt with every movement of the feet. The animal evinces great restlessness, removing the weight frequently from one limb to the other, and, where it is confined to the fore-feet as is usually the case, the body is balanced on the hind feet which are brought well under the trunk. The hoofs are sometimes hot, at others cold, and the arteries of the legs forcibly pulsate or throb.

*Treatment.*—Place the animal in slings so as to relieve the feet from the weight of the body. Give a bold dose of purgative medicine, and place the feet in warm bran poultices, or pour ice-cold water over them. But omit the purgative after undue retention of the afterbirth.

If the animal can be induced to lie down so much the better. Should the pain be severe give a dose of opium, and repeat it as often as may be necessary. When the pain and lameness have subsided, and the animal is capable of walking, ten minutes' gentle exercise on soft ground two or three times a day will prove beneficial, and at the same time a blister may be applied over the coronets of the affected feet.

**GREASE.**—This disease consists in a discharge of stinking matter from the heels. It usually commences with redness and heat in the heel of the foot; to this cracks succeed; then considerable swelling, occupying the whole of the pasterns, which are exceedingly tender, and smoke as the horse stands in the stable. At length small fleshy growths begin to spring from the heels and soon extend to the fetlock. On the first appearance of grease the horse should have a dose of physic. To this should succeed alterative and diuretic balls, either alternated or given together, and, if the horse is in poor condition, a course of tonic medicine may follow.

When there is simple redness and heat of the heels, the white lead ointment will cool them and render them supple. It is best made by rubbing down one drachm of white lead with seven drachms of lard. When cracks have commenced, they must be poulticed with linseed meal, or mashed turnips or carrots. The inflammation being subdued, a saturated solution of blue vitriol or alum may be applied three or four times a day. The diet in these cases should be light, given in small quantities and often, instead of in full rations. Bran, carrots, mangel, and, in the springtime, green food will be found most suited to the disorder. When grapes appear, a skilful veterinary surgeon alone can decide on the course to be pursued.

**CORN.**—A corn is a bruise on the sole. It is mostly seen in the angle of the inside heel near to the end of the shoe. To expose it, a layer of horn requires to be cut away with the drawing knife, when a

blood-stained patch appears. If the discoloration is near to the surface the injury is an old one and may be of no account, but if it is deep down, near to the quick or sensitive sole, it is of recent occurrence and is invariably attended with lameness.

Horses having flat spreading feet with low weak heels are specially liable to corns, but under certain circumstances all descriptions of feet may suffer. For the most part they are to be referred to bad shoeing, but bruises are sometimes inflicted accidentally by the lodgment of stones between the shoe and the bars or frog.

*Symptoms.*—Corns give rise to lameness in proportion to the severity and extent of the injury. In progression the foot is brought to the ground with an inclination towards the outer side, so that the weight is removed from the injured part. The inner quarter of the hoof is hot, and in severe cases swelling of the pastern and fetlock may appear by extension of the inflammation upwards. This sometimes leads to the error of attributing the lameness to sprain of the enlarged joints. In severe and neglected cases an abscess may form in the foot and “break out” at the coronet, giving rise to what is termed a quittor.

*Treatment.*—If the lameness is severe the corn must be well pared—that is, the blood-stained horn must be removed nearly down to the quick, and if matter has accumulated it must be let out. The foot should then be placed in a pail of hot water for an hour, and afterwards transferred to a warm bran poultice. The latter should be changed two or three times a day, and continued until the lameness passes away. To complete the cure it may be necessary to apply a blister over the coronet and cold swabs to the foot, or to use a three-quarter shoe.

Horses subject to corns require careful shoeing, and may be allowed to wear leather soles with advantage.

**NAVICULAR DISEASE.**—This is one of the most common of equine ailments, and, at the same time, the least amenable to treatment. It consists in an inflamed and ulcerated condition of a small bone in the foot termed the navicular bone (see fig. 92, page 399). Light horses engaged in fast work as hunters, hacks, and harness horses are most frequently its victims. It is undoubtedly hereditary (page 410), and so much so in some instances as to make its appearance in quite young horses even as early as three years of age. The great majority of cases, however, are the direct consequences of long continued work and wear on the hard roads of our commercial towns. Horses with high action are very prone to it, especially if the feet are strong and blocky, or low, flat and weak, or where the pasterns are upright and wanting in length and elasticity.

*Symptoms.*—Navicular disease is generally gradual in its onset, and slowly but surely progressive in its course. In the early period of the attack the symptoms are never very diagnostic. A slight alteration in the animal's gait is first noticed after a hard day's work, when the fore limbs appear to lack their usual liberty of action, and there is a slight tendency to trip and stumble. The movements soon become stiff, and later on lameness shows itself in both fore limbs, not equally but

slightly in favour of one or the other. For a short period the lameness is specially marked in the near leg, and then in the off one, or *vice versa*. This repeated change in the relative degree of lameness in the two limbs arises out of the fact that the animal in saving the foot in which the disease is most severe aggravates it in the other, which is called upon to do extra work in supporting the weight of the body. In progression there is a tendency to go on the toes or front part of the foot, the action becomes short and restricted, the knees are not bent, and the shoulder movements become very limited. It was this peculiarity which, in past times, led to the belief that the shoulder was the seat of disease.

As the malady progresses the feet gradually waste and become smaller, in the course of which the heels contract, the quarters become deep and upright, the frog shrinks, and the sole presents a concave or hollowed-out appearance.

In the stable, or while at rest, the patient stands with one foot in advance of the other, and there is a tendency to "knuckle over" at the fetlock joints.

*Treatment.*—Navicular disease once established is incurable, but something may be done to retard the progress of the malady and prolong the animal's services. The measure of success in this direction will depend upon the stage in which treatment is commenced. Early resort to blisters applied over the coronets frequently, during a run at grass of two or three months, is invariably attended with benefit, and the same may be said of setons applied to the frogs. Where it is desired to keep the animal in work the feet may be immersed in a cold bath for an hour or two each day, or cold swabs may be applied to them when the horse is at rest. Shoeing with leather rings, or well-fitting rubber pads, will break the "jar" and afford relief to the aching feet during work. Where these measures fail there only remains to divide the nerves of the leg and deprive the diseased parts of sensibility. This operation has at once the effect of removing the lameness, but it does so by withdrawing all sense of feeling from the foot, and not by arresting the disease.

**SIDEBONE.**—A sidebone is a hard unyielding substance situated on the side of the coronet, from which it extends backwards towards the heel, and for a little distance upwards beyond the hoof. In this disease the lateral cartilages, which in a state of health are elastic, become converted into bone, when they are found to be hard and rigid. Sidebones may appear on the inner or the outer side of the coronet, or both. The fore feet suffer much more frequently than the hind ones, and heavy horses are much more liable to them than those of the lighter breeds. It is worthy of remark, however, that since the adoption of veterinary inspection at our leading shows, a marked diminution of this troublesome ailment has taken place in our draught horses, and especially in those of the Shire breed.

Among the causes which conduce to sidebones hereditary predisposition, or an inbred tendency to their development, is strongly

marked in some families: hence horses and mares suffering from them should not on any account be used for breeding purposes. Of the exciting causes, treads and bruises over the coronets in early life are perhaps the most common. Young horses working in deep heavy ground when tired, and turning at the headlands, are liable to tread each other and themselves, and thus excite inflammation and bone formation in the cartilages. Many cases are referable to cart shafts being allowed to fall upon the coronets while horses are being unyoked. In towns where cart-horses are made to trot over the stone pavement concussion of the feet is no doubt a fruitful cause of the disease.

The presence of sidebones is recognised by the unyielding state of the lateral cartilages. Lameness is not always present and some horses appear to suffer little or no inconvenience from them, but in the majority of instances they prove a serious impediment to locomotion. Where this is the case the patient should be thrown out of work and caused to stand with his feet in cold water two or three hours a day. Opening the walls of the hoof by what is known as "Smith's operation," will frequently give marked relief.

RINGBONE consists of a bony enlargement between the coronet and fetlock joint. When it is nearer the former it is termed "low ringbone," when towards the latter it is spoken of as "high ringbone." Usually it is confined to the front of the pastern, but it sometimes extends round to the back and encroaches on important ligaments and tendons whose action it impedes. In this position it is productive of serious lameness which rarely altogether disappears notwithstanding the most active treatment.

*Causes.*—Predisposition to ringbone may be transmitted from parent to offspring (page 410). Horses with short upright pasterns are more liable to contract the disease than others in whom greater length and elasticity of the parts more effectually oppose concussion. External violence is a fruitful cause of these bony excrescences. Young animals, when tied up for the first time, often strike their pasterns against manger posts or halter logs while pawing, and excite inflammation and enlargement of the bones. In towns, where horses do fast work on stone pavement, it arises out of concussion and sometimes from falls, treads, and other forms of direct violence.

*Treatment.*—As in sidebones, so in this disease, the treatment will consist in reducing inflammatory action by physis and cold water immersion, or warm fomentations, and then blistering or firing, or both, combined with long rest.

SPAVIN.—Spavins are commonly spoken of as bog spavin and bone spavin. The former is a fluctuating swelling on the inner and front part of the hock, and arises out of a distension of the joint capsule with fluid (synovia or joint oil). The latter is an enlargement on the *inner and lower* part of the joint, involving the small bones which enter into its composition.

Bog spavins, although frequently of large dimensions, are often caused to disperse, but bone spavins once developed remain permanent and unmovable.

*Causes.*—Like ringbone and sidebone, spavins are also much influenced in their origin by hereditary predisposition (page 410), and also by conformation of the limbs. Horses with small weak hocks, especially if associated with short quarters and upright pasterns, appear to suffer most, although spavins are sometimes found in the best looking and most perfectly constructed joints. Sprain to the ligaments, and jar or concussion to the bones, such as occur in jumping, rearing, kicking, and travelling through deep ground, are the most fruitful causes of the disease, and their potency for mischief is greater in the young than in the aged. Adult horses resist the force of violence much more effectually than young undeveloped colts, hence it is more especially during the early periods of life that these troublesome ailments appear.

*Symptoms.*—In addition to the enlargement, which may be small and difficult of recognition, or large and prominent, there is usually more or less lameness. In the stable the horse stands with the leg flexed in a resting position. If made to move over in the stall he does so with a limp, and, when caused to trot, the defective limb is carried stiffly with the hock joint unbent. The foot is made to meet the ground toe first, and the heel is raised and freed from the weight of the body. On this account the front part of the shoe manifests a good deal of wear, and sometimes the toe of the foot is also much rubbed down by contact with the ground. Spavined horses improve in their action after travelling a short distance, or, as it is expressed, "throw the lameness off," but if allowed to stand for a time after exertion the lameness quickly reappears and continues for a while worse than before.

*Treatment.*—Where horses suffer from lameness behind, the hock joint should be carefully examined, and, if it is found to be hot and swollen, a dose of physic should be given at once, and warm fomentations applied to the part. This may be continued until the heat subsides and the lameness becomes less considerable, when cold water bathing may be substituted for warm. Should the enlargement remain at the seat of spavin, a high or wedged heel shoe should be applied to the foot, and blistering may be resorted to and repeated at intervals of a fortnight. This failing, firing either by "puncture" or "lining" may be called in aid. Some prefer the introduction of a couple of setons over the enlargement, which has the advantage of causing little or no disfigurement. In all spavin cases, plenty of time should be allowed after the disappearance of the lameness before work is resumed, or a return of the mischief is most likely to result.

*SPLINT.*—Splints are small bony outgrowths usually situated on the inner side of the cannon bone, between the knee and the fetlock joint. They are also seen on the outer side. Very few light-bred horses are free from them after reaching the age of four years.



The most important factor in their origin is inheritance, which can be traced in a very large percentage of cases.

Concussion is no doubt the chief exciting cause, as the prevalence of splints would appear to have increased with the higher development of what is now regarded as fashionable action, and with the hardness and resistance of our roads. Blows inflicted on the shin of one limb by the foot of the other may also induce them.

Splints do not always occasion lameness; when they do so it is either the result of inflammation in the bone and its covering, or of mechanical interference with the growth of the tendons and ligaments behind the limb. The degree of lameness is not always in proportion to the size of the splint. Very small ones may excite acute lameness, while large ones, when placed in a forward direction may develop without producing any at all. The most serious and lasting lameness from this cause arises where the excrescence encroaches on the knee and interferes with the play of the joint.

It is not always easy to decide whether a splint is causing lameness or not. In determining this point the age of the animal must be taken into account. Old horses comparatively seldom suffer from splint lameness. If when the affected part is pressed upon the horse suffers pain and snatches away the leg, and if at the same time the limb is moved somewhat stiffly from the knee, and there is no other obvious cause of the defective movement, the case may be dealt with as one of splint lameness.

*Treatment.*—Rest, and the application of hot bandages for a few days, and a dose of physic in the meantime, are usually sufficient to subdue the existing pain and lameness. When, however, this is not the case, the part should be blistered once, or oftener, at intervals of ten days. Obstinate cases must be met by firing, or the insertion of a seton over the growth, or by cutting through the covering of the bone. These operations will require the services of the qualified veterinarian, and should not be attempted by the amateur.

**POLL EVIL** is, as the term implies, a disease of the upper part of the neck, immediately behind the setting on of the head. In past years, when stables and stable doors were low, and bridles and head stalls were heavier than they are now, this was a very common ailment in horses, and especially those of the heavy breed. The disease consists in an inflamed and swollen condition of the tissues of the "poll," which in the majority of instances results in the formation of an abscess. The mischief is usually the result of mechanical injury. This may be brought about by horses "hanging back" when tied up in the stable, by wearing heavy bridles, by striking the poll against the manger while picking up food from beneath it, or against the wall when cast in the stable, or in falling over when rearing. In some cases it is the result of blows inflicted by sticks and heavy whips, and less frequently it follows upon sprain and laceration of the muscles of the poll, resulting from horses pitching forward on their head.

*Symptoms.*—The symptoms presented in this disease are first marked

by stiffness of the neck: the head is poked out and the horse turns with difficulty. Examination of the poll shows more or less heat and tenderness to pressure, and there may be a wound from which matter is discharged.

*Treatment.*—When the disease is recognised in its early stages the inflamed part should be fomented with hot water two or three times daily, or—what is better—poulticed until the inflammation disperses. A dose of physic given at once will materially aid in bringing about this result. Should “matter” form, the presence of which will be known by the appearance of a soft boggy swelling, fomentations may be discontinued, and the abscess laid freely open with a knife. The further treatment now depends very much upon the extent of the disease, the depth and direction of the wound, and the parts involved, and will require the advice and assistance of a qualified veterinary surgeon.

*CATARACT.*—The term cataract is applied to a small white, opaque spot in the interior of the eye. It occurs in that part of the organ known as the crystalline lens, and once established remains permanent through the life of the animal. In some instances it is not larger than a pin's point, when special means of examination are employed for its detection. In others it reaches the dimensions of a pea, and in some cases involves the whole of the lens. In these extreme examples the whole interior of the eye exhibits a white milky aspect, and sight is completely destroyed.

The tendency to cataract is hereditary, through a disposition which some horses inherit to inflammation of the structures of the eye. It may, however, arise from accidental causes, such as blows and other injuries.

Although cataract constitutes unsoundness (page 411) it does not necessarily interfere with the services of the animal. We have known many hunters so affected which have performed years of good work without inconvenience or mishap.

*Bots.*—These troublesome parasites, infesting the stomach and intestines of horses, are the grubs or larvæ of a two-winged fly, known as the horse-bot fly, *Gastrophilus equi*. For the following details our thanks are again due to Miss E. A. Ormerod.

The flies are from half an inch to two-thirds of an inch in length. The male has the end of the abdomen blunt, the female has it prolonged, as shown in the accompanying figures 147 and 148, the former affording a side view (2) of the ovipositor as curved under the body. The colour is yellowish brown, with black or dark markings on the body between the wings and down the abdomen. The somewhat shaggy hair is very various in colour, being black or brown or yellowish or whitish, so as to make it difficult to describe the colouring clearly; in some specimens it is variegated with chestnut or foxy colour on the abdomen. The long ovipositor of the female is of a shining black brown colour.

The two wings are moderately large, closed together when at rest, hyaline, sometimes opaque white: with a transverse brown or grey band and two spots, or a slight marking at the tip. The legs are long

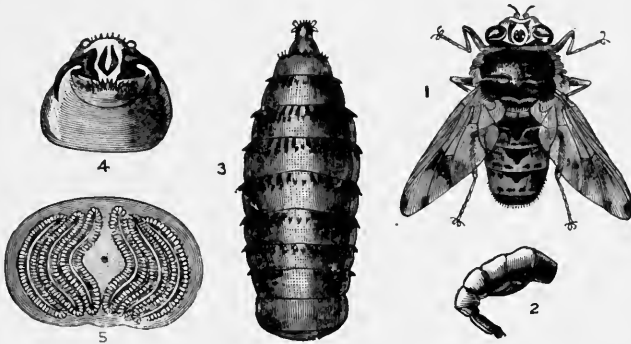


Fig. 147.—Horse Bot Fly (Horse Bee), *Gastrophilus equi*, Fab.

1. Horse Bot Fly, male. 2. Curved extremity of abdomen of female. 3. Maggot. 4. Mouth hooks. 5. Spiracles at extremity of tail of maggot, all magnified, after Brauer.

in proportion, smooth, and mostly yellowish brown. The fly is known by the various names of the Great Spotted “Horse Bot Fly;” the “Horse Bee;” and also, from one of the places it selects for egg-

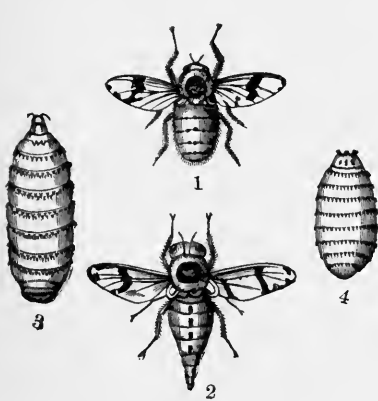


Fig. 148.—Horse Bot Fly.

1. Male. 2. Female. 3. Maggot. 4. Chrysalis, nat. size, after Bracy Clark.



Fig. 149. — Eggs of Horse Bot Fly, nat. size and magnified, after Bracy Clark.

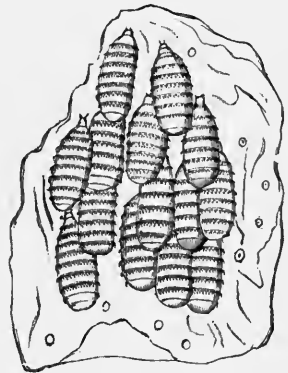


Fig. 150. — Maggots, or Horse Bots, attached to Membrane of Stomach, after Bracy Clark.

laying, as the “Knee Bot Fly.” In Europe it is to be found from June or July until October.

The eggs (Fig. 149) are hardly the twelfth of an inch long, white, spindle-shaped at one end, and obliquely truncate at the other, and are

attached by the female bot fly to the hairs of the horse. The hair of the mane, the shoulders, and the inside of the knee, are places especially chosen for egg-laying. The method of deposit is for the female fly to poise near the horse, and then, flying at the spot, to leave the egg fixed to the hair by a glutinous moisture, and so to continue until four or five hundred eggs may be laid on one animal. Her whole supply is believed to be as many as seven hundred.

The eggs are ready to hatch in a period variously stated as from about five days to three weeks. How the maggots are conveyed into the horse does not appear to be an absolutely settled thing; some *may* possibly creep through the hair to the mouth. The most commonly received opinion, however, is, that the moisture and warmth from the horse's tongue when he licks the spots where the eggs are attached hatches them, or, rather, helps to free the maggot if near hatching time, and the maggot being produced adheres to the horse's tongue. Thus a number of larvæ from the many eggs laid are conveyed into the mouth, whence they pass downwards, or are carried downwards with food and water from the mouth to the stomach.

There the maggots fix themselves to the mucous membrane by means of two dark brown hooks (see Fig. 147, 4), one of which is placed on each side of the slit which serves for a mouth, and there they nourish themselves by suction. As they grow older they alter in shape, and are considered to pass from eight to ten months in maggot state, attached by their mouth hooks to the lining membrane of the non-digestive portion (page 404) of the stomach.

Fig. 150 shows a number of partly grown bot maggots attached to the membrane of the stomach. By this time they have gained their characteristic form, which is somewhat barrel-shaped, banded round at intervals by lines of prickles or horny points. When full-grown they loosen the hold of their mouth hooks, by which they have kept themselves in position, and passing along the intestines are discharged from the animal, and fall to the ground. They bury themselves in the horse dung, or in the ground, and there turn to brown chrysalids (formed outside the hardened skin of the maggot), from which the fly comes out in about six or seven weeks during summer.

*Prevention and Remedies.*—Combing, brushing, clipping hair at the infested spots, and the use of soaps and washes, which would not be in any way injurious to the horse, whilst they would help to clean off eggs and maggots, are amongst the regular methods of treatment. Any safe wash or smear with a strong odour of carbolic acid or mineral oil, or any other scent obnoxious to the flies, would of course be a deterrent of attack.

An experienced veterinary surgeon states that he knows of no medicine that will destroy the bots, or make them leave their winter quarters until fully developed. A good feed of grass in early spring induces them to detach themselves the soonest. As a medicine, 2 oz. of turpentine and 20 oz. of raw linseed oil mixed, and given as a draught once a fortnight, is the best remedy; *i. e.*, if it is thought the loss of flesh and condition by the horse is due to the presence of bots.

## CHAPTER III.

## ON THE DISEASES OF SHEEP.

**H**USK OR HOOSE is a form of bronchitis resulting from the presence of thread-like worms (*Strongylus filaria*) in the air passages. In its acute form it is confined to young animals (not only lambs but also calves), and seldom affects older sheep. Autumn is the time when our flocks suffer most, although the disease is made known to the careful observer as early as July or August. The young of the "Husk" parasite are hatched out in the lungs, and are subsequently expelled in the act of coughing. On reaching the soil they take up their abode in the body of the earth-worm, where they undergo a certain phase of development, and afterwards re-enter the lungs of the sheep to complete their growth and propagate their kind.

*Symptoms.*—The symptoms of husk are mainly confined to the breathing organs. It is usually the case that a large number of the flock are affected at the same time, or become so in rapid succession. Coughing is the first sign of its presence, and this continues for some weeks without any material discharge from the eyes and nose such as marks a common cold. The cough is frequent, and sometimes violent and distressing. It is most troublesome in the early morning and the cool of the evening, and is soon excited under exertion. As the disease advances the lambs lose condition, the appetite is capricious, and the breathing becomes hurried and laboured. Later on diarrhœa appears and adds to existing depression, and unless relief be afforded this is succeeded by exhaustion and death. In outbreaks of this kind the first opportunity should be taken to examine the lungs after death in search of the parasite, the presence of which removes all doubt as to the nature of the affection.

*Treatment.*—Animals affected by this disease should be placed on a dry pasture with ample protection from cold easterly and north-easterly winds. They should not be hurried or chased by dogs, but kept as quiet as circumstances will permit. A liberal ration of corn, cake, and bran should be allowed daily, and with it sulphate of iron and salt may be given as an alterative and tonic, to enrich the blood and support strength. A dose of turpentine every third day until three doses have been administered is highly recommended by experienced veterinarians and shepherds.

As a preventive it is a good practice not to pasture lambs on clover or grass which has been eaten off by old sheep, especially if any of the latter have suffered from chronic cough or wasting. Where the disease has made considerable advance, and great prostration exists, the sick lambs should be housed in a warm dry stable. If diarrhœa is acute, a little brandy with a few drops of tincture of opium and a few grains of nutmeg should be given twice daily in a tablespoonful of linseed tea.

BRAXY.—This is a blood disease closely allied to if not identical with anthrax.

*Dry Braxy* in which constipation of the bowels forms a leading feature, and *Water Braxy* characterised by diarrhœa, are the two forms in which the disease presents itself.

*Symptoms.*—Great excitement, a staggering gait with rapid breathing, and staring blood-shot eyes are the first indications of the malady. Then succeed a rapid, throbbing action of the heart, more or less violent straining, discolouration of the urine, and ultimately an inability to stand. Constipation or diarrhœa may be present and in some instances the paunch becomes distended with gas, or gas from putrefaction of the blood and tissues is found beneath the skin, causing swelling of the body and a crackling sensation when the part is touched. When unable to rise the animal struggles, moans, and grinds its teeth, and soon succumbs to nervous exhaustion.

*Treatment.*—The rapidity with which this disease runs its course renders curative measures of little avail. Many of those attacked are found dead, without having been noticed to be ailing during life. When the malady appears, measures of prevention should be early resorted to. If the flock is thriving too rapidly the sheep should be removed to a spare pasture and receive a small daily allowance of bran, with just sufficient cake-meal to induce them to eat it. With this should be given hyposulphite of soda and common salt, once or twice daily, until the disease ceases. Animals already suffering must be taken up and drenched with Epsom salts, and a little blood may be removed by opening the vein at the lower angle of the eye. By some authorities exercise is also deemed desirable at the outset of the affection, to overcome the tendency to stagnation and to uphold the circulation.

JOINT-ILL.—Lamb life has no more deadly foe than the disease known by the term “joint-ill.” Once it assails its victim it seldom quits the young creature without doing irreparable mischief. The nature of the malady is scarcely yet understood. Rheumatism, scrofula, and various other ailments have been thought to be the cause of the disordered joints which are so frequently identified with it, but recent experience has pretty conclusively shown it to consist in a state of “pyæmia” or poisoning of the blood. Most cases of joint-ill are caused by the entrance into the system of an organism known as the “Necrotic Bacillus,” the lamb becoming infected through the unhealed navel, and as the bacillus abounds in dirt, the necessity of cleanliness and use of disinfectants is apparent in preventing this disease. “Dirty lambing pens and careless dirty shepherds,” remarks Professor Axe, “are the bane of the lambing flocks, and supply all that is needful to contaminate the wound in the navel, and start a centre from which the blood stream may be fatally polluted.”

*Symptoms.*—Dulness and loss of appetite, with a harsh “staring” condition of the wool, are the first signs of ill-health. Stiffness and

lameness in one or all of the limbs soon follow, and then painful swellings appear about the joints and sometimes in other parts of the body, notably beneath the throat and on the arms, thighs, and trunk. There are fever, thirst, emaciation, and weakness. In some instances there are no enlargements; the disease centres itself in the internal organs, especially the lungs and liver, where abscesses form and extensive disorganisation follows. Here there is sudden prostration, inability to stand, high fever, hurried, panting breathing, and later diarrhœa and fœtid breath, with hoven and a yellow state of the membranes of the eye.

*Treatment.*—Curative measures of treatment are seldom of much avail where the malady has become established. A writer in the "Live Stock Journal" properly points out: The attention of the flock-master must be concentrated in the direction of arresting its spread, and this must be done by giving prompt and special attention to the ewes and the condition of the lambing pens.

The ewes should be placed on a good nutritious diet, and if large quantities of turnips are being allowed the amount must be reduced; while at the same time such animals as are diseased should be as far as possible avoided. The healthy must be separated from the sick, and the lambing pens should be thoroughly cleansed and disinfected, or, what is better, removed to another part of the field or farmstead.

Give salt and sulphate of iron to the ewes, and a plentiful supply of nutritious food morning and evening, to improve the general health. All lambs born after the appearance of the disease should have their navels carefully examined, and dressed for the first two or three days or longer with a solution of carbolic acid, the young animals being folded on clean dry litter.

Fouling of the pens should be carefully guarded against, and cleanliness on the part of the shepherd must be strictly enforced.

To the diseased lambs a little castor oil may be given when constipation exists, or, if diarrhœa be present, a little carminative and astringent mixture may be prescribed.

**LOUPING-ILL OR TREMBLES.**—These terms are used by flock-masters and shepherds to designate a form of disease affecting the nervous system, in which paralysis, convulsive leapings or "loupings," and trembling of the limbs are the leading features.

It is seldom seen in England, but prevails largely throughout Scotland, and especially in certain parishes and districts. In some parts it is said to be "circumscribed by the windings of a river, and without any ostensible cause, or it is fatal on one slope (south) of a hill, while the opposite escapes; or again, it prevails on the richest table-lands." Lambs, and sheep under eighteen months old, are equally its victims, and every variety of breed, both native and imported, succumbs to it. May and June are the months when it is most prevalent, but it also occurs to a less extent in September.

*Cause.*—Although much has been done by veterinarians and flock-masters to trace out the origin of the disease, nothing approaching to

the solution of the question has at present been arrived at. Land whose fertility has been increased by liming is said to induce it, and some observers have seen reason to connect it with sudden changes of temperature. In the Highland and Agricultural Society's Transactions for 1883, Professor Williams announced the discovery of a minute organism in the spinal canal, to which the affection was said to be due, but the methods of investigation adopted by Professor Williams hardly warrant us in accepting the conclusions at which he arrived.

*Symptoms.*—Louping-ill comes on suddenly, and may speedily result in death or continue for several weeks. The first appearance of the disease is shown by an unsteady gait, resulting in partial or complete paralysis either of the hind extremities alone or of the whole body. In some instances the animal bounds forward in convulsive leaps, or the head, limbs, or trunk, or all of them in turn, are seized with violent and repeated twitching movements in the form of sudden contractions of the voluntary muscles. A bright glassy appearance of the eyes and drooping ears are also marked features in some cases, and in others the appetite is ravenous and depraved, to such an extent that dirt, sand, and even stones may be greedily swallowed.

*Treatment.*—The adoption of curative measures of treatment cannot at present be recommended with any hope of success. Animals attacked should be destroyed at once, and attention directed to measures of prevention. In this connection it should be remarked that, where a tendency to the disease exists, ewes intended for breeding purposes should not be less than two years old. They should be selected from a sound healthy strain, and well conditioned at the time of going to the tup. Land recently limed is to be avoided, and a high standard of health maintained during pregnancy by good food and shelter.

Throughout the lambing season special care should be taken to protect the young from exposure to cold easterly and north-easterly gales, and a liberal ration of nutritious food should be provided for the ewes from the time of lambing onward.

**SCAB.**—This is a parasitic disease due to a minute parasite termed *Acarus scabiei* (or *Psoroptes communis*, Fürst. var. *ovis*), or mange mite, which burrows into the skin, and in so doing causes much itching and a scabby eruption. It is essentially contagious, and is readily transmitted from one animal to another. The subject is discussed in Sir George Brown's paper "On Sheep-Scab in its Relation to Sheep Husbandry" (*Journal of the Royal Agricultural Society*, 3rd series, vol. vi., 1895, p. 529).

*Symptoms.*—The presence of this disease is shown by uncontrollable itching. The affected animals rub themselves forcibly against posts, rails and gates, upon which locks of wool are usually found where the disease prevails. The fleece presents a ragged appearance, and the skin is repeatedly being nibbled at various points where the mites are at work. If the body is scratched with the finger the animal looks round in the direction of the part touched, and describes a nibbling movement with the mouth. Examination of the skin shows the presence of scabs, and of bald places where the integument is thickened



and excoriated, or, in more advanced disease, deep sores are found, as well as fragments of skin in a dead and sloughing condition. Small red raised spots are also observed here and there marking fresh points of attack of the parasite. The diagnostic indication of the disease is the discovery of the acarus. This may be made by taking a portion of the scab and examining it under a lens of moderate power; or if placed

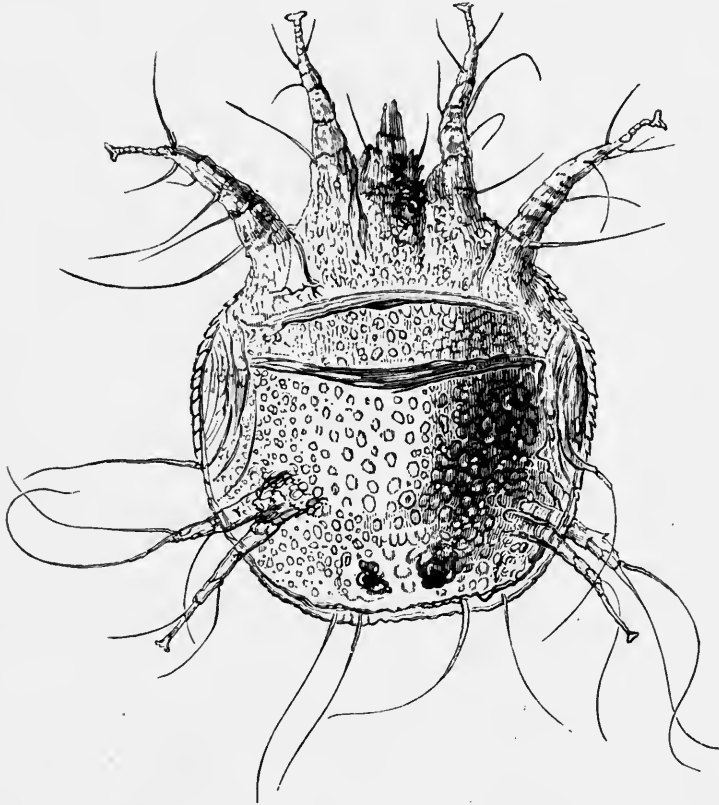


Fig. 151. —Mature Female Acarus, from a Sheep affected with Scab.

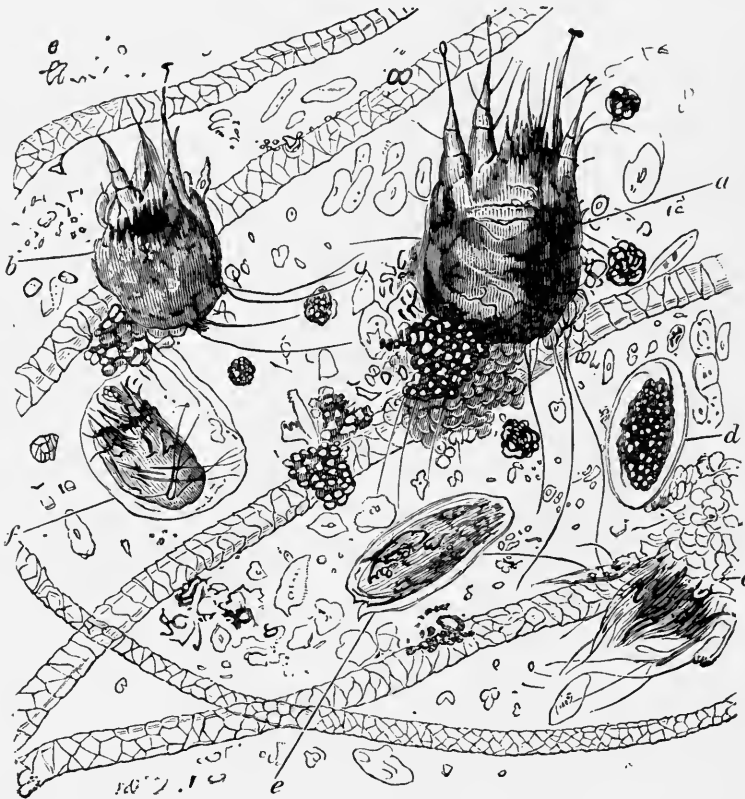
(Drawn with the camera. Magnified 100 diameters.)

on a piece of black paper near the fire the acari may be seen with the unaided eye moving towards the warmth.

*Treatment.*—Various agents are employed in the treatment of this disease such as decoction of tobacco with sulphur, or lime with sulphur, or corrosive subhmate, mercurial ointment, arsenic, &c. The least troublesome and most inexpensive mode of dealing with an infected flock is to use one of the many preparations of “sheep-dipping composition” now so largely sold by druggists and others.

Pastures, buildings, yards, sheds, pens, &c., in which scabby sheep

have been placed, retain their contagious properties for some time. If the weather be hot and dry the acari left behind suffer from shrivelling up and drying, and from three to eight days are required to destroy



**Fig. 152.—Acari in Various Stages of Development, Intermingled with Wool and Masses of Scab.**

- a.* Mature female acarus lying in a mass of scab.
- b.* Young acarus after change of skin.
- c.* Cast-off skin of an acarus.
- d.* Ovum, with the yolk contracted.
- e.* Ovum, containing a young acarus.
- f.* Ovum, with young acarus in the interior about to be hatched.

(Drawn with the camera. Magnified 60 diameters.)

them effectually; but if the atmosphere be moist and warm, they will retain their vigour and activity even after a much longer period.

FOOT ROT consists primarily of an inflamed condition of the sensitive tissues contained within the hoof. Writing of this disease, Professor Axe says that animals having a thin supple skin and a fleece of fine texture are most liable to it, and possibly for the reason that the hoofs

in such creatures are wanting in stoutness, consistence, and powers of resistance. They are consequently readily torn, broken, or otherwise deranged under the peculiar conditions to which they are exposed.

Some authorities regard the disease as contagious, and under certain circumstances it would seem to be so.<sup>1</sup> It is known to result from well defined causes of a common character, such as (1) a febrile condition of the feet induced by long journeys, leading to a dry brittle state of the horn, and subsequent cracking; (2) excessive wear of the hoof and exposure of the sensitive structures within it; (3) the long continued application of wet to the feet, resulting in rotting and tearing of the hoof and the entrance of dirt into the vascular tissues; (4) it is also seen on sandy and gravelly soils during hot weather, when the hoof becomes dry and brittle, and cracks appear which give lodgment to sand and other foreign matter; (5) the mechanical irritation of short stubble acting on the cleft of the foot is a fruitful cause in wet weather; (6) it also results from the impaction of hard clay between the digits, and from standing on hot litter. Many examples of the last-named cause are seen in ewes when confined to the lambing pens.

*Symptoms.*—Lameness, more or less severe, is observed in one or more limbs. The affected feet are hot and tender, the horn is ragged and easily torn. The vascular structures are laid bare, and in severe cases the digits are much swollen, and general inflammation with deformity of the entire foot exists. When the disease continues for any length of time, locomotion is interfered with, the animal fails to seek its food, and loses flesh. Sometimes the bones of the feet are affected, and there is much suffering and constitutional disturbance.

*Treatment.*—The first step in the course of treatment is to remove the diseased sheep on to a dry surface, such as a well littered yard or shed. The feet are then to be examined, and all loose horn carefully removed with a sharp knife. One of the many caustic or astringent agents in common use may next be applied to the diseased part if necessary. The remedies usually employed are the mineral acids—nitric, sulphuric or hydrochloric—or a solution of a caustic or of bichloride of mercury. The astringent agents are the sulphates of copper, iron, or zinc, or alum, used in the form of saturated solution.

Corrosive mixtures should not be too frequently applied, and the feet should be kept dry during the course of treatment.

A method of dealing comprehensively with a large number of sheep is described on page 519.

**LIVER ROT.**—This is one of the most destructive maladies of sheep, and in some seasons flocks have been decimated by its ravages. The disease is associated with the presence in the liver of trematode worms, known as liver flukes. The mature fluke has the same shape as a sole or a flounder, but is not much more than one inch long. The fluke parasite (*Fasciola hepatica*, or *Distoma hepatica*) has a complicated life-history, involving an alternation of generations. The eggs of the

<sup>1</sup> The reader may be referred to the Royal Agricultural Society's pamphlet, *Contagious Foot Rot in Sheep*, by Sir George Brown, C.B. Price 6d. London: John Murray. 1892.

fluke pass from the sheep on to the grass, and the embryo then emerges from the egg, and takes up its abode in the soft body of the small water-snail, *Limnæus truncatulus*, the elegant, spiral, pale buff shell of which is only about a quarter of an inch long. Within the body of the snail the parasite undergoes further changes, and eventually the sheep, feeding on moist herbage, takes in either the small infested snail, or possibly some of the parasites that have deserted the snail for the herbage. The flukes make their way from the stomach to the liver of the sheep, and the cycle is repeated.

*Symptoms.*—From four to thirteen weeks may elapse after ingestion of the parasites before functional disturbance becomes apparent. Between November and January, however, the sheep becomes less lively; the mucous membrane about the eyes, the nose, and the gums turns pallid; and the animal shows a tendency to grow fat. At the beginning of the year the sheep commences to get lean, becomes listless and dejected, and other disorders, such as diarrhœa, are the precursors of death. Aqueous cachexia, rot, rot dropsy, sheep-rot, liver disease, liver fluke, jaundice, yellows, and verminous phthisis of the liver, are other names for liver rot, and are all expressive of one stage or another of this disastrous malady.

*Treatment.*—This involves liberal feeding, a free use of salt, and a change of pasture from damp, low-lying lands, to those that are high and dry. Sheep should not be allowed to graze water-meadows or damp pasture in the autumn, but only in the spring when, after the frosts of winter, they may reasonably be expected to be free from the parasites. When there is no alternative to the grazing of wet land it has been recommended that one portion should be used for sheep to the end of May, and another portion for the exclusive autumn feeding of sheep, horses alone having grazed the land in spring and summer. When the sheep are transferred from the spring feeding grounds to the autumn grounds, horses replace them on the spring lands. Dressings of lime or salt, or of both, spread over the grass lands at the proper season, will have the effect of destroying the embryo flukes and the snails which harbour them. Sheep should not be allowed to graze infected lands too closely.

**RETENTION OF URINE.**—An inability to empty the bladder, whereby the urine is caused to accumulate and distend the organ abnormally, is not infrequently observed in sheep. It is mostly seen in males, and particularly rams, while being got up for exhibition purposes, under the influence of rich highly stimulating food.

The chief cause of this defect as seen in sheep is due to the presence of minute sandy particles, which block up the urinary passage at the extreme end of the penis (worm). This gravelly matter is deposited from the urine while in the bladder, and then passing along the canal becomes arrested in the small worm-like appendix of the organ, thus shutting in the urine and preventing its escape. The deposition of sandy matter in the bladder is said by practical flock-masters to arise from the excessive use of mangel and other food rich in sugar. We

think, however, that the want of exercise and the habit of going for long periods without emptying the bladder, as do fat lazy sheep, has much to do with it.

*Symptoms.*—Where retention of urine exists the patient becomes restless, frequently shifts his position, groans, grinds his teeth, and strains. The breathing is quick and panting, the heart's action is hurried, and all food is refused. Examination of the bed shows an absence of moisture owing to no urine having been discharged. The over-distended bladder may be felt by introducing the finger into the rectum.

*Treatment.*—The object of treatment is to be directed to the removal of the obstructing matter. This may sometimes be effected by rolling the small end of the penis between the thumb and first finger and squeezing the sandy matter gently forward towards the outlet. Should this fail the "worm" may be slit up with a fine knife, or, better still, removed altogether. When these measures do not succeed the animal should be killed. Inflammation of the bladder and rupture of the organ are the common consequences of delay.

## CHAPTER IV.

### ON THE DISEASES OF SWINE.

**SWINE PLAGUE OR SWINE FEVER.**—This is a specific fever of a contagious and infectious character. Until Professor Axe showed it to be a distinct disease it was regarded by many, both here and on the Continent, as a form of anthrax.

Like most, if not all, other spreading affections, it has its origin in a minute organism which enters the body through various channels, and induces disease by its growth and multiplication in the blood and juices of the flesh.<sup>1</sup>

In a series of experiments performed by Professor Axe in 1877, it was proved that the poison of this affection may enter the body by the lungs in the act of breathing, by the stomach in the act of feeding, or by inoculation through open wounds. The same observer also showed that the virus is given off from the skin as well as from the bowels. In this way the ground on which infected pigs stand, and over which they travel, as that of markets, styes, yards, and roads, becomes contaminated and rendered liable to extend the disease to healthy stock which may follow them.

*Symptoms.*—The period of incubation is stated by Professor Axe to vary between four and eight days, after which there is a rise in the body temperature, and the skin becomes more or less reddened and scurfy, particularly about the ears, on the under surface of the arms

<sup>1</sup> The most recent experiments appear to prove that, although a particular organism is always present in the bowels in cases of swine fever, the disease is really produced by a mixed infection, that is to say, another organism is also in operation, and by lowering the resistant power of the pig, allows the swine fever bacteria free play to exercise their baneful influence. Swine erysipelas, commonly known as "Red Soldier," is distinct from "Swine Fever," and it seldom occurs as an epizootic in this country, although isolated cases occur.

and thighs, and over the breast and belly. Sometimes blisters and scabs appear on the skin, and, in protracted cases, the ears and tail may shrivel up and slough. The stricken beasts are dull and huddle together, or bury themselves in the litter, from which they show no desire to move. On being made to do so they are found to stand with their backs up and their tails drooping. There is a discharge from the eyes, sometimes also from the nose. Early in the disease the movements are feeble, and the animal becomes progressively weak. Sooner or later diarrhœa sets in, the belly is tucked up, and the legs are drawn under the body. Where the lungs become involved, as frequently happens, there is a cough with more or less difficulty of breathing. In some instances the animal becomes stupid, giddy, or even delirious, and, in this condition, vision is impaired, and it may be that the hind parts become paralysed, and the body generally is convulsed.

Swine plague is dealt with under the Contagious Diseases (Animals) Acts, wherein it is provided that any Local Authority may, if they think fit,—

I. Cause any swine affected with swine-fever to be slaughtered; or

II. Cause any swine being or having been in the same pig-sty or shed, or in contact, with swine affected with swine-fever, to be slaughtered.

It is further provided that the Local Authority shall, out of the local rate, pay compensation as follows for swine slaughtered under this article:

- (a.) Where the pig slaughtered was affected with swine-fever the compensation shall be one half of its value immediately before it became so affected, but so that the compensation do not in any case exceed forty shillings.
- (b.) In every other case the compensation shall be the value of the pig immediately before it was slaughtered, but so that the compensation do not in any such case exceed four pounds.

The general health rate of the pig is higher than that of any other of our domesticated animals. This is no doubt in some measure due to the fact that swine are killed young, and consequently only a few are exposed to the risk of suffering from the numerous ailments incidental to old age and decay.

In relation to the health of the younger members of the pig herd the temperament of the dam must be considered. Irritable, ill-natured sows, however robust they may be, seldom do justice to their litters. Many sows are so constituted as to be made furious by ordinary disturbing causes; thus, a sore teat, a chapped udder, or the irritation due to the sharp tusks of the sucklings frequently provokes a constant state of excitement and restlessness. The influence of temperament on the quality of the milk is now generally recognised, and the ill effects of milk furnished by animals under conditions of excitement and restlessness are often very marked. The sudden and repeated attacks of diarrhœa from which young pigs suffer arise from this cause more frequently than is commonly supposed.

## BOOK THE SEVENTH.

ON THE BREEDING, REARING, AND MANAGEMENT OF POULTRY.



### CHAPTER I.

#### DOMESTIC FOWLS.

SINCE the days when the noted author of this work first made it the expression of his knowledge and his ideals, a great change has taken place in respect to Domestic Fowls. The habits and means of the people have been much modified, and a new factor has entered into our life which was then practically unknown. It is true that cock-fighting has been suppressed, but the breeders of game-cocks for this, as Youatt termed it, "abominable species of gambling," have been replaced a hundred times over by the modern fancier, who, even if his interest is not directly connected with farming, annually produces a large amount of nutritious food. With the fancier as such we have nothing to do, but this much must be said for him, that during the dark days of neglect of poultry by agriculturists he preserved many breeds, and introduced others, which are amongst our most valuable fowls to-day. Happily these days seem to be fast passing away, and an amount of attention is being given to the production of eggs and poultry, such as would have been undreamt of a few years ago. Still, the words written early last century apply equally to-day, though the development of inter-communication throughout the country has placed all parts more on an equality than in olden times, and we find the poultry-keepers of Devonshire supplying eggs to the tables of residents in the Midlands, and the peasantry of County Mayo sending vast quantities to Lancashire and Scotland.

But we must look chiefly to the farmer on a small scale, as it is he who can easily and advantageously occupy himself in this pursuit; whilst the cottager may frequently contrive to add not a little to his savings, or his comforts, by the rearing of chickens, or the production of eggs. In the neighbourhood of large towns, where the sale is ready and extensive, the rearing and fattening of poultry for the market should become a regular business, and be as scientifically conducted as any portion of the employment of a grazier. For poultry, if properly

managed, not only repay the trouble and expense of their keep, but afford a very considerable profit to the rearer and dealer. Yet how few persons seem aware of this, or at any rate how few there are who pay to this branch of farm stock that attention of which it is so well worthy!

Though considerable study has been devoted to the question as to the origin of the domestic fowl, we appear as far from a settlement thereof as ever. Naturalists are agreed to a certain extent, beyond which there are differences that they are unable to settle. For a time the opinion of Darwin that all our domestic fowls are derived from one stock, the *Gallus Bankiva*, or wild fowl of India, found almost general acceptance, but doubts have more recently been thrown upon this view. The problem, therefore, still continues unsolved, and, in the absence of clearer information than we have yet been able to obtain, it is likely to remain so. One thing, however, is certain, namely, that the majority of our breeds of fowls are derived from the wild fowl mentioned above, and also that all our breeds trace their origin to Eastern and Southern Asia.

It is evident from the tone of Darwin's writings that he was aware of the somewhat slender evidence in support of the theory that domestic fowls are all descended from one species, for he says in his work "On the Variations of Animals and Plants under Domestication" (Vol. I. p. 251), "We have not such good evidence with fowls as with pigeons, of all the breeds being descended from a single primitive stock. In both cases the argument of fertility must go for something; in both we have the improbability of man having succeeded in ancient times in thoroughly domesticating several supposed species—most of these natural allies—all being now either unknown or extinct, though the parent form of no other domesticated bird has been lost." The remarkable variations in many species led the great naturalist to the belief that his opinion was the correct one, and that all fowls owe their origin to the *Gallus Bankiva*.

Until recently Darwin's theory was accepted, but in the "Field" of September 26th, 1885, there appeared a letter by Mr. W. B. Tegetmeier, from which it would seem likely that the generally accepted theory may after all be wrong. "The origin of all the different varieties or breeds of the domestic fowl is usually believed to be the common wild India jungle cock, the *Gallus ferrugineus* of modern naturalists, but known also as the *Bankiva* fowl (*G. Bankiva* in the older books). This bird may be readily described as closely resembling a small black-breasted red game-cock, with a tail carried more horizontally than usual. It may be regarded as most presumptuous in me to dare to contest the conclusions arrived at by the honoured master Darwin, with whom and for whom it was for some years my privilege to work; but a careful and extended consideration of the facts has led me to a different conclusion to that arrived at by him."

After describing observations of his own, made as to the different types of *Gallus*, which had led him to first question Darwin's decision, Mr. Tegetmeier goes on to say:—



“But it is with regard to the Eastern Asiatic type of fowl that my doubts as to the descent from the *G. ferrugineus* are strongest. We have in the Cochin a fowl so different from the ordinary domestic birds that, when first introduced, the most ridiculous legends were current respecting it. Putting these on one side, we have a bird with many structural peculiarities that could hardly have been induced by domestication. Thus the long axis of the occipital foramen in the Cochin is perpendicular, in our old breeds horizontal, a difference that could never have been bred for, and which it is difficult to see could be co-relative with any other change. The same may be said respecting the deep sulcus or groove, up the centre of the frontal bone. The extraordinary diminution in the size of the flight feathers, and in that of the pectoral muscles, could hardly have been the result of human selection and careful breeding, as the value of the birds as articles of food is considerably lessened by the absence of flesh on the breast. Nor is the extreme abundance of fluffy soft body feathers a character likely to be desiderated in a fowl. The vastly increased size may have been a matter of selection, although, as the inhabitants of Shanghai feed their poultry but scantily, and, according to Mr. Fortune, mainly on paddy or unhusked rice, it is not easy to see how the size of the breed was obtained if, as generally surmised, it arose from the little jungle fowl.

“Taking all these facts into consideration I am induced to believe that the birds of the Cochin type did not descend from the same species as our game fowl. It may be asked what bird I would suggest as the origin of these Eastern Asiatic breeds. In reply I would suggest the possibility, or even probability, of their being descended from some easily captured and readily domesticated short-winged species, that may have entirely passed into a state of domestication, as has the camel and the horse. I can see no inherent impossibility in this suggestion, nor any fatal objection to the theory I have advanced.”

We have, therefore, got just thus far, namely, that there is more than a doubt in the minds of naturalists,—for Mr. Tegetmeier is not alone in his opinion,—as to the theory advanced by Darwin. The idea is that we must go farther back to find a common progenitor, one which was the parent of all the four species of *Galli* that have been named.<sup>1</sup> It is very interesting to note that the first advancement of this view was not from a naturalist, but from a poultry-breeder, the late Mr. Lewis Wright.

It may, therefore, be accepted without question, that the original home of the fowl was in Asia, whence have come so many of our domesticated animals. The tracing of the ways by which they left their first habitat and have come down to us in the forms now seen would be of great interest, but is beyond our purpose. It will suffice to say that from India the fowl migrated to Persia, and thence to Europe. Many references are made to it in ancient literature, and the evidences show that it was known in Syria and Eastern Europe at least six centuries before the Christian Era. So soon as civilization commences its benign influence the fowl begins to appear, finding

<sup>1</sup> *Gallus Sonneratii*, *Gallus Stanleyii*, *Gallus furcatus*, and *Gallus Bankiva*.

its greatest cultivation where agriculture and manufactures attain their highest development. It was not long after its introduction that the ancients began to take advantage of the natural combativeness of the cock, and thus to minister to their own ideas of pleasure. Literature contains many references to cock-fighting, for the fights between cocks became a striking theme for poets as soon as the fowl was a familiar object. In the "Eumenides" of Æschylus, Athena warns the Athenians against civil war as resembling the combats of cocks. Pindar compares the inglorious victories of civil war to the victories of a barn-door fowl. And it is stated that Themistocles raised the courage of his soldiers by reminding them how two fighting-cocks risk their lives, not for the hearth and its Penates, but for fame alone. The fighting cock was sacred to Ares and Pallas Athene. Plutarch states that at Sparta, on the close of a campaign, two kinds of sacrifice were in use: he who had attained his end by craft and persuasion sacrificed a bullock; he who had gained it by fighting, a cock. A superstition peculiar to the rocky town of Methana, between Epidaurus and Troezen, mentioned by Pausanias, is likewise connected with the worship of Apollo in that district. To avert the evil influence of Libs, the south-east wind, on the vines, two men would cut a cock in halves, and each run with one-half in opposite directions round the vineyard, and then bury the bird on the spot where they met. Soon after the appearance of cocks and hens in Greece, whole families of fowls must have been transported to Sicily and South Italy, and there, as in Greece, they spread from house to house. The oldest representations of the cock on coins and vases, in Greece, Sicily, and Italy, do not extend beyond the second half of the sixth century B.C.

So much for the origin and wanderings of the domestic fowl. We shall have something to say as to the modern evolution of breeds in the next chapter. But we must now look at the present state of affairs in respect to poultry matters both at home and abroad, for there is a much wider question involved than that of race and breeds. Poultry-keeping may give pleasure to large numbers of people, but unless it can be profitable to individuals and to the nation at large, it must sink to the level of one of those pursuits which are as fickle as fashion.

Since the first edition of "The Complete Grazier" was published there has been a vast change in the consumption of poultry products and the farmers at home have not by a long way met the increased demands, consequently we see the volume of imports from abroad advancing year by year. In fact, it is to be questioned whether the home production is as great as it was fifty years ago, for the era of large farms has operated against the old yeoman farmer class, who were large producers of poultry. Be this, however, as it may, the fact remains that we import from abroad enormous quantities of eggs and poultry, and that these imports are rapidly increasing nearly every year. In 1856 our imports of eggs were chiefly from France, and in that year were valued at £278,422. In 1907 France only sent us about one-fifteenth of our foreign supply, and yet we paid to that country the sum

of £541,088, whilst Russia sent us over one-third and received £2,392,044. The following figures are from the Board of Trade Returns:—

IMPORTS OF EGGS INTO THE UNITED KINGDOM.

Year.		£
1864.	2,777,485 long hundreds, <sup>1</sup> in value	835,028.
1869.	3,684,709           "           "	1,126,853.
1874.	5,672,049           "           "	2,433,134.
1879.	6,388,838           "           "	2,295,720.
1884.	8,275,553           "           "	2,968,927.
1889.	9,416,639           "           "	3,122,813.
1899.	16,174,760          "           "	5,044,392.
1907.	18,517,891          "           "	7,134,532.

In addition to eggs, the Poultry imported in 1907 amounted in value to £903,847, so that our total indebtedness to foreign countries for this branch of our food supply, in the last-named year, was rather over eight million pounds sterling. Ireland is a part of the United Kingdom, and its products cannot be regarded as coming from abroad, but it is a producing country, and it supplies vast quantities to the larger island. The latest returns show that the supply of eggs and poultry sent from Ireland must annually reach about two and three-quarter million pounds in value. Thus we at once see how important is the whole question, and it is obviously suggested that if the foreign producer can profitably supply our markets, paying carriage over long distances, and only realising the lower prices here, surely the home-producer could have done the same. Nor has there been any great diminution of price, as in the case of other kinds of produce, but, on the contrary, eggs and poultry are dearer to-day than ever they were, except during some abnormal period. Both demand and price have been in favour of the home producer, but that supineness which has permitted the foreigner to capture the butter trade to such an enormous extent, is seen here also, and a large London retailer has declared that he prefers the foreign eggs because he can depend upon them all the year round, while they are more carefully packed and sorted than any English eggs he can buy.

It must be acknowledged, however, that recent years have witnessed a change in the feelings with which this subject is now regarded. The pressure of circumstances and the force of events have compelled attention to those smaller products which at one time were thought beneath notice. The keeping of poultry by farmers is becoming more and more favourably regarded, and the signs of the times are that there will be a considerable development in this direction. There can be no question that in this country the tendency is towards the moderate-sized farm, and this fact, combined with the great increase of Dairying, to which Poultry Keeping is a kindred pursuit, will be greatly helpful to the end we have in view. There are, indeed, to-day, farmers who make a

<sup>1</sup> A long hundred is 120 eggs.

considerable amount of money out of their poultry. Some time ago we visited a large dairy farm in Cheshire, a farm by the way which has been awarded prizes for being one of the best kept and best managed in that county, and where poultry are very extensively bred and reared, chiefly for the sake of their eggs, which are sold in one of the towns to which it is contiguous. Here we found that the fowls were a constant source of profit. Our visit was paid in the month of October, and all the eggs were then being sold wholesale at  $1\frac{1}{2}d.$  each. It is under such conditions as these that poultry can be made profitable, for there is no rent to pay; food is cheap, much of it being gathered by the birds themselves; and what labour is involved simply fits itself in with the other work of the farm. We could not obtain any specific statistics, for the plan adopted is to give each flock into the hands of one of the farmer's sons, of whom there are seven, and they work on their own account, receiving the proceeds as a perquisite, of course paying all out of pocket expenses. As each is enabled to save money, there can be no doubt as to the undertaking being profitable.

Crossing the English Channel, we find that the poultry kept by French farmers and peasants are an important source of income, in fact, in many cases, the chief source. But there are no such things as poultry farms *per se*, in spite of all that has been said to the contrary. One of the most remarkable developments has been in Denmark, where the growth of poultry-keeping has been phenomenal. There it is entirely a question of production on farms, and the industry has added greatly to the prosperity of the country. In America a large increase has taken place, but almost entirely as a branch of farming. The huge poultry plants concern themselves chiefly with sale of stock, birds, and eggs for hatching, and the same is true with us. Breeding establishments are a necessity, and afford an excellent opportunity to specialists, but they contribute only a moiety of the food supply in eggs and poultry.

Whilst eggs are the staple part of the poultry industry, the production of chickens, ducks, geese, and turkeys is found also to be very profitable. And it is here that we observe, in some parts of the country, a better state of things. The poultry raisers of Surrey and Sussex, whose birds command the highest prices on the London markets, and those of Devonshire, who supply the vast needs of the South-west coast and send large quantities of eggs to the Midlands, the duck breeders of the Vale of Aylesbury, and the goose and turkey breeders of East Anglia and Cumberland, prove what can be done when attention is given to the matter. Their success is sufficient to dispel the idea that poultry will not pay in Britain, and to prove that the notion so long held that the French have the advantage in soil and climate is false. The fact is that there is no better country for poultry raising than the United Kingdom. Its climate is humid, its pastures are rich, and the consumer is at hand. Given these conditions, it is the fault of the producer, and of him alone, if he is outstripped in the race, especially at a time when the demand for eggs and poultry

is rapidly extending. If the same ratio be maintained during the next twenty years as within the last two decades, we shall be paying fifteen million pounds annually for foreign poultry produce, unless farmers and cottagers take the warning afforded by the past, and secure the benefit for themselves. That there will always be a large import of eggs from abroad is certain, for they are now extensively used for manufacturing purposes, but with this trade no one would seek to interfere, as the cheap eggs from the Continent are equally suited to these processes, and are much lower in price. The best demand, that for the table, is what the home breeder should seek to supply.

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## CHAPTER II.

### THE BREEDS OF POULTRY, AND THEIR CHARACTERISTICS.

**W**ITHIN recent years there has been a marked increase in the varieties of our domestic fowl. Whereas at one time the different varieties could have been counted on the fingers of both hands, now their name is legion. These changes have been due to various circumstances. Climate, soil, and natural selection have all had their influence in the matter, but the chief factor has been artificial selection by man, and his constant seeking after improvement and change. The whole globe has been scoured for new types of fowls, which when received have been developed, altered, perhaps improved, perhaps spoiled. Never was poultry breeding carried to such a length as today, and wherever the Anglo-Saxon race has gone there we find poultry breeders at work. Though they may have made mistakes in some cases, the general value of their work is beyond doubt, and, but for their efforts, there would not be such a choice of valuable breeds as is now available. These breeds have individual characteristics and special qualities by which their value can be determined.

Poultry may be divided into five great sections, namely :—

1. Generally useful fowls.
2. Non-sitting, or Laying varieties.
3. Table varieties.
4. Water-fowl and Turkeys.
5. Ornamental Poultry.

We proceed to give some details respecting each of these sections.

#### 1.—GENERALLY USEFUL VARIETIES.

By this term is meant those breeds which are not specially characterised by the development of any one quality to the lack of others, but

are fairly good all round—good sitters, good mothers, laying a fair number of eggs, and making average table fowls. They partake largely of the Asiatic type, that is, are large in body, with substantial shanks, high tail, and of rotund contour. They have one decided advantage, namely, that they are usually good winter layers, and for this reason their produce is more valuable than that of many other breeds which lay twice as freely. This is to some extent discounted by the fact that, as might be expected from the size of body, they are large eaters. Their heavy build, especially amongst the feather-legged

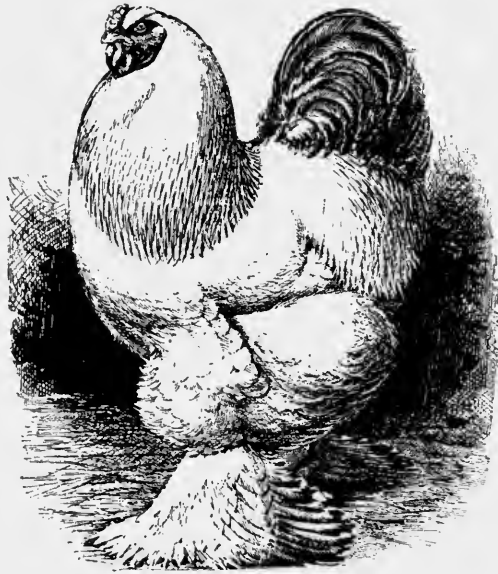


Fig. 153.—Light Brahma Cock.

varieties, prevents their being very good foragers, in which respect the American breeds have certainly a great advantage, as they are clean-legged. The leading groups of the generally useful fowls are as follow:—

*Brahmas*.—Two colours, the dark and the light (fig. 153). Profusely feathered, both on hocks, legs, and feet. Neat head, with pea comb. Were once much better in economic qualities than is the case to-day. Development of hocks has affected laying. Eggs are rich and tinted in shell, as, in fact are all in this section.

*Cochins*.—The breed which created such a *furor* forty years ago. It is broad, deep, and massive in body, with a very round appearance, and extremely heavy in feathering, the hock, leg, and foot feathers being excessively developed. There are five colours, the black, the

buff, the cuckoo, the partridge, and the white, the second and fourth named of these being the most popular. Cochins cannot be recommended for economic properties, for though good winter layers the maternal instinct is highly developed.

*Langshans.*—Of this breed there is only one variety, which is black in colour, longer in the leg than the Brahma or the Cochin, with a sprightlier carriage, and like the letter Y in shape (fig. 154). The comb is single, the legs are only slightly feathered, and the habit is active. Unfortunately, breeding for exhibition has done great harm, as the show type is very long in the leg, and has lost its original qualities. The "Croad" Langshan is to be preferred.

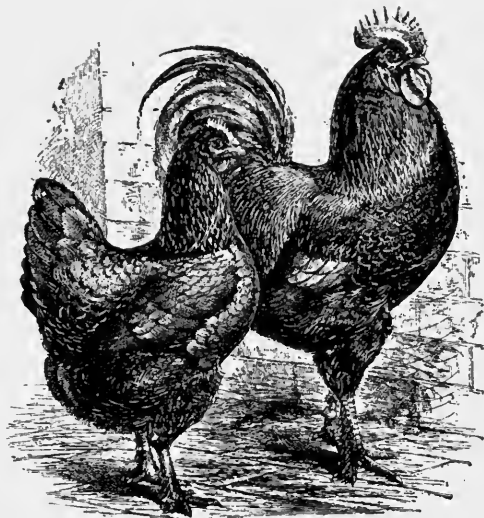


Fig. 154.—Prize Langshans.

*Orpingtons.*—Originally there was only one variety of this breed, the black, made up of one-half Langshan, one-quarter each Minorca and Plymouth Rock, following the Langshan type but with clean legs. Another is the Buff Orpington, similar in shape, but with white legs and feet. This has proved one of the most valuable races ever introduced, and as an essentially economic fowl, good for meat and as a winter layer, it has found acceptance in all parts of the world. The combination of white flesh and skin with the production of tinted shelled eggs is found very seldom. It is a fairly quick

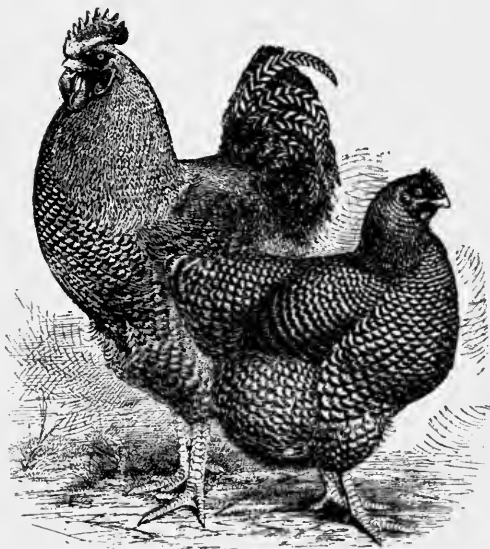


Fig. 155.—Plymouth Rocks.

grower, very suitable for the spring trade, and the flesh is well distributed.

*Plymouth Rocks.*—This breed has been cultivated in Britain for nearly thirty years, and during that time has advanced to almost the first

position in respect of popularity. It is a manufactured breed, and partakes much of the Cochin shape, but is clean legged (fig. 155), and markedly superior in economic qualities. The comb is single and the legs are yellow. Of it there are four colours—the barred, by which is meant that every feather is crossed with narrow back bars on a white ground; the white, the buff, and the black, these being self-coloured. It is an excellent variety for economic properties, good as a layer in winter, an admirable sitter and mother, a rapid grower, and makes an average table fowl. It is to be found everywhere, and appears to have the important merit of adapting itself to all conditions.

*Wyandottes.*—Of this breed, for which we owe another debt of gratitude to American breeders, there are at present several colours. These include the silver, which was the original, the gold, the white, the buff, the black, &c. The breed is undoubtedly a composite, and several varieties have been concerned in its production. The shape is that of the Brahma, but it is clean legged; the comb is rose, like that of the *Hamburgh*, and the marking in the silver and the gold is, or ought to be, black lacing on a silvery white or a golden bay ground, like the lacing which has hitherto been peculiar to the *Sebright Bantam*. They are very hardy indeed, excellent layers of rich eggs, grow rapidly to a large size, and make good table fowls, but have the yellow legs which are sought for in all American breeds.

In addition there are two other breeds, known as the *Javas* and the *Dominiques*, but these are so little bred that it is needless to say more respecting them.

In selecting, we should recommend to farmers, in the order named: for

*Winter Layers.*—*Langshans*, *Plymouth Rocks*, *Wyandottes*, and *Orpingtons*.

*Early Chickens.*—*Plymouth Rocks*, *Wyandottes*, *Orpingtons*.

*Cold Exposed Situations.*—*Wyandottes*, *Plymouth Rocks*.

## 2.—THE LAYING, OR NON-SITTING VARIETIES.

Of these there is quite a large variety, all of which, without exception, have been developed in Western and Southern Europe. The most numerous are known as the *Mediterranean family*, and include *Anconas*, *Andalusians*, *Leghorns*, *Minorcas*, and *Spanish*. These have spread very widely, as they are wonderful layers of large, white-shelled eggs. They are very sprightly in carriage, of medium size in body, moderately long in the neck, with a rather prominent breast, and flowing tail. The legs are medium in length, and the head is surmounted by a large single comb, standing upright in the cock, and falling gracefully over in the hen. In all the ear-lobe is white, but in the *Spanish* this has been permitted to spread so much that it not only covers the face, but hangs down several inches below it. The *Hamburgh* is another large family, but they are more of a fancy breed, as their eggs are too small for market purposes.

*Anconas.*—A variety which is excellent as an egg producer, and is hardy. The plumage is speckled, or mottled.



*Andalusians*.—Sometimes called the Blue Spanish, for with the exception of the white face it is the same in all other respects. The colour of the plumage is deep blue on the breast, the rest of the body a deep slate blue, with lacing of darker colour, save in the cock, where the hackle and sickle is of a rich glossy black, or a deep purple. It is fairly hardy, but does not stand unfavourable conditions so well as do some other breeds, and should not be kept in confinement.

*Hamburgs*.—Of these there are five colours, namely, the Blacks, the Gold pencilled, the Gold spangled, the Silver pencilled, and the Silver spangled. The blacks and the two varieties of spangles have been bred in Britain for generations, chiefly in the counties of Lancaster and York, and they are at once exceptionally good layers,—in fact, the best layers we have,—and beautiful birds. The pencilled varieties

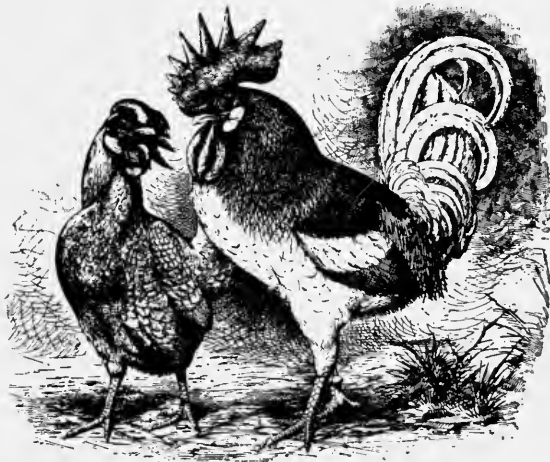


Fig. 156.—Pile Leghorns.

Introduced by Mr. G. Paynè, Woking.

come to us from Holland, where they, or the progenitors of our much improved pencilled Hamburgs, are called Campines. For the reason already stated they are not to be recommended for farmers.

*Leghorns*.—The most important of the Mediterranean races, splendid layers, moderate for the table, and very hardy. At first there were only two colours, but these have been greatly added to since the time of their introduction, about thirty years ago. In addition to black and white, the varieties now known are—brown, buff, chamois, cuckoo, duckwing, pile (fig. 156), and rose-combed. The browns and the whites are the most popular, the others being variations which are chiefly of interest to those who keep poultry for the sake of pleasure, though one or two may become more popular. The white is self-coloured, the brown has markings like black-red game fowls. All have yellow legs. At a recent meeting of the Newcastle Farmers' Club (November, 1890), a large Northumbrian farmer stated that his

White Leghorns had averaged 160 eggs in ten months, and that he found this variety the best as layers.

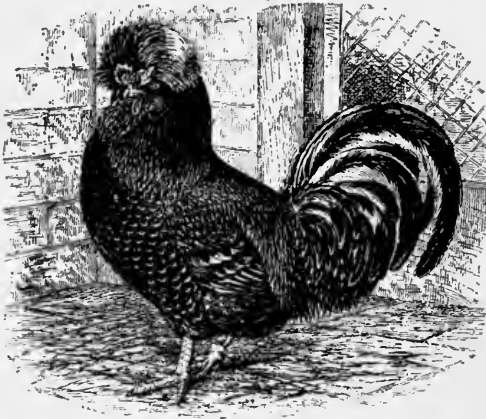


Fig. 157.—Houdan Cock.

the head is surmounted by a moderate sized crest (fig. 157). The plumage is speckled black and white, the former predominating. It is an excellent layer, a good table fowl, hardy, and well suited to farmers.

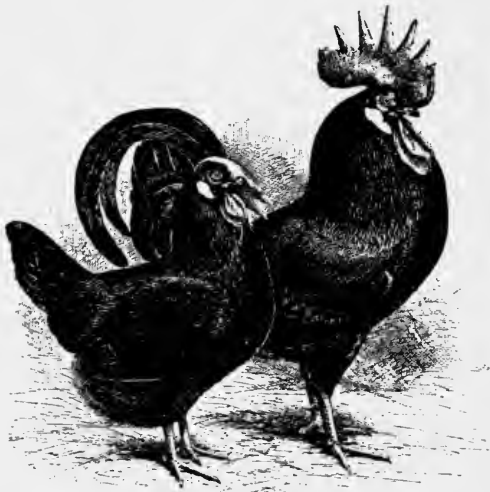


Fig. 158.—Black Minorcas.

*Houdans.* — The best known of the French varieties, almost all of which are non-sitters, even where they are bred for the table. The Houdan has been very widely spread, and at one time appeared to be about the most popular of all the later introductions, but it has been eclipsed by the Mediterranean and American breeds. It is a large fowl; with a squat-like body, and clean legs, the feet bearing the fifth toe, thus showing its relationship to the Dorking, which it resembles in shape. The comb is that known as leaf, and

*Minorcas.* — Sometimes known as red-faced Spanish, but whilst the latter were developed in Holland with an excessively white face, the Minorcas have been bred in Devon and Cornwall more on the original lines. It is a pure black fowl in one variety, and pure white in the other, but the latter is seldom seen. The body is medium in size, with that square appearance, associated with moderately long legs, which is characteristic of the Mediterranean races. The comb is exceptionally large (fig. 158), and the legs are black or white. It is the best layer of all, if we

except the Hamburg, and, where eggs are the first consideration, cannot be beaten, the Minoreca being hardy and an excellent forager.

*Polish.*—These come more into the category of fancy varieties, for, though they are undoubtedly excellent layers under favourable conditions, they are too delicate for such an object as that under consideration. There are six colours, the chamois, the ermine, the gold spangled, the silver spangled, the white, and the white-crested black. The most notable characteristic in this breed is the large crest surmounting the head.

*Redcaps.*—A breed which has recently come into notice as a remarkable layer. It would appear to be an unimproved gold-spangled *Hamburgh*, and probably the progenitor of the latter variety, as it has the same colour and shape, though the markings have not been perfected as in that breed. The name is derived from the enormous comb surmounting the head, not unlike a cap in shape,—a loosely fitting *Tam o' Shanter cap*. It is equally prolific with the *Hamburgh*, but the eggs are much larger in size, and consequently it is of more value for practical purposes.

*Spanish.*—Reference has already been made to the white face of the *Spanish*, which has been bred to such an extent that the natural stamina of the breed has been lost, and though an excellent layer of large white-shelled eggs, it is too delicate for practical purposes. There are three colours, the black, the blue, and the white, the first named being the most common.

*Scotch Greys.*—A very valuable breed, which as its name would imply has been chiefly bred in *Scotland*. It has somewhat of the *Mediterranean carriage*, though perhaps is more like the *Dorking*. It is large in body, has a single comb, and white or mottled legs, the body being white in ground colour, with markings of neat black moons on every feather. They are good layers, capital table fowls, and hardy, bearing confinement well. They are well suited to the purpose in view, as the quality of the flesh is superior to that of most of the non-sitting varieties.

In selecting we should recommend—in the order named—as the *Best Layers*,—*Leghorns*, *Minorcas*, *Redcaps*, and *Scotch Greys*.  
*Best Layers, and on the Table*,—*Scotch Greys* and *Houdans*.  
*Hardest*,—*Anconas*, *Leghorns*, *Redcaps*, and *Scotch Greys*.

### 3.—TABLE VARIETIES.

By this term is understood those varieties which are specially bred for their edible properties, both as regards the quantity and the quality of their flesh, the point aimed at being the maximum of flesh with the minimum of bone. With a few exceptions, nearly all the best of the table varieties are somewhat delicate in constitution, and need to be kept where the conditions are favourable. By this it is not necessarily meant that the climate must be mild, for the *Dorking* thrives in the North of *Scotland*, but that there shall be a dry, porous soil. Size is an important consideration in these breeds, and the best have their flesh chiefly on the breast, where it is finest in quality. A bird that carries a large amount of flesh on its thighs can never be a first class

table fowl. The breeds in this section do not excel as layers, in which respect some are decidedly poor.

*Dorkings*.—This well known old English breed has for centuries been regarded as one of the finest of all table fowls. Its origin is lost in the distant past, but it would appear as if we owe the breed to the Romans when they invaded Britain, for at that time there existed in Italy a breed with very similar characteristics. During more recent years it has been largely bred on the hills and in the valleys of Surrey and Sussex, where it is produced in great numbers for the supply of the London markets. But it has spread widely, and under the conditions already named it is found a most profitable breed, growing rapidly and to a large size. The original type seems to have been a speckled fowl, similar to the four-toed Sussex, which has now been re-introduced. Of

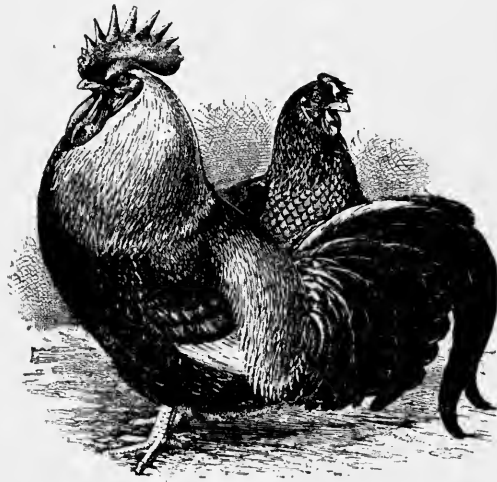


Fig. 159.—Dark Dorkings.

that there are three colours, but of the Dorking there are four colours, the dark or coloured, the cuckoo, the silver grey, and the white. Placing the cuckoo last, as it is a variety not much bred, the others are popular in the order here named, the darks being the largest in size of body. The true Dorking shape is that of an almost oblong square, the back being the upper side, the breast and the rump the respective ends (fig. 159). In all real Dorkings there is an enormous breast development; the keel being both deep and long, carrying a large amount of flesh. The neck

is somewhat short, and the shape of combs varies, the darks and the silver greys having single combs, and the other two varieties rose combs. The legs are rather short, and should be pure white; the feet are also white, and carry five toes, which is a distinctive feature of the Dorking.

*French*.—The feeding and fattening of poultry have been brought to a fine art in France, and the display of dead poultry annually made at the Mardi Gras show in Paris is the most wonderful sight of this kind to be met with anywhere. Their large size, delicacy of skin, and whiteness of flesh make these fowls a wonder to behold. But the same thing, though perhaps not to the same degree of perfection, can daily be met with in the markets of Paris and other large French cities. Nor is it only a question of fattening, though this has undoubtedly much to do

with it, for a great difference is to be noted in the various breeds as regards their quality of flesh. The varieties which are best in this respect are La Bresse, La Flèche, Le Mans, and Crève Cœurs. Of these La Flèche and Crève Cœurs, both of which are black in plumage, are best known out of their native country. It must be conceded, however, that the French varieties are rather delicate, and do not stand the rigours of our climate very well, consequently they have never been introduced to any large extent. Further, they have black legs and feet, and though the prejudice against these is not nearly so powerful as was the case a decade or two ago, it is still present, and militates against the breeds. A very useful breed is the Faverolle, especially for a second grade trade. It is an excellent layer.

*Game.*—The game fowls have always been famous for their table qualities. The develop-

ment of breast muscle, to give them great power of striking, has made the breed exceptionally good in this direction. The

modern game fowl (fig. 160) is a much leggier bird than his progenitor, but breeding for limb has not destroyed his fine table properties, though it may to some extent have affected him in size of body. Of late there has been a revival of interest in the old type of game fowl, and the institution of classes for it at the Royal and other leading shows has brought it to the fore. It is also excellent for crossing

purposes. The colours of both old and new type which are most popular are the black-breasted reds, the brown-breasted reds, the piles, and the duck-wings, the first named being very valuable indeed, and very rich in colour. It is worthy of note that many of the old-fashioned type are white in leg,—always a recommendation in a table fowl.

*Indian Game.*—This is a variety which has been very largely bred in Cornwall, and has taken a firm hold on public favour. It is larger in body than the English game, and has more substantial shanks, with a thicker head (fig. 161). The amount of meat on one of these birds is remarkable, but the flesh and skin are very yellow, which is an objection in the best markets, and the flesh is rather hard. They have yellow legs. Practically, their great value is for crossing with soft and white fleshed races such as the Dorking and the Orpington.

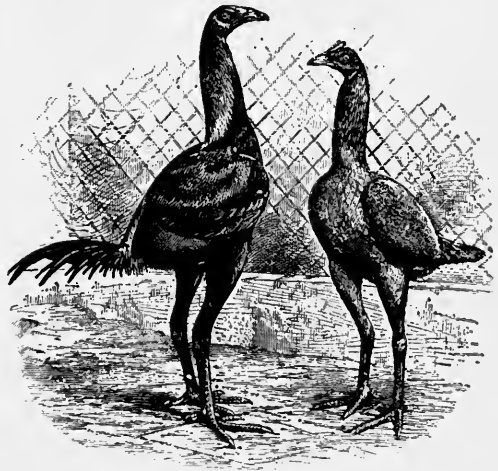


Fig. 160.—Modern Black Red Game.

Winners of Challenge Cups, Birmingham, 1889.  
Bred by Captain Heaton, Worsley.

In selecting we should recommend, in the order named :

*For Quality of flesh*,—Dorkings, La Flèche, Crève Cœurs, and Old English Game.

*For Hardiness*,—Indian Game and Game.

Those whose object is to breed table fowls for the market would do well to study the question of crossing, for by this means greater size can be obtained, and the softer flesh of the Dorking or the French can

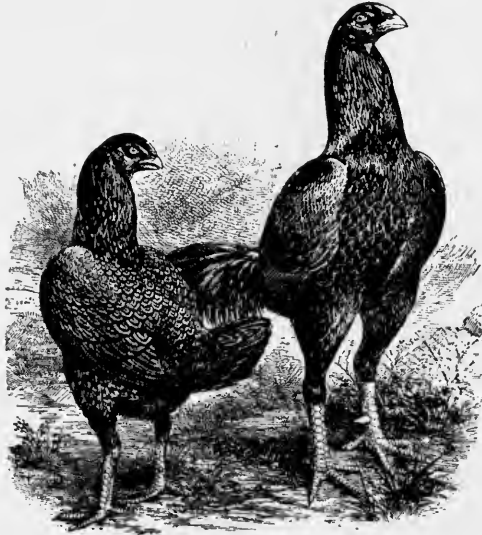


Fig. 161.—Indian Game.

be engrafted on the Game and Indian Game. We would suggest the following crosses, Indian Game—Dorking, Indian Game—French, Game—Dorking, Game—French. Indian Game—Langshan makes a good cross where the Dorking is too delicate for the locality.

#### 4.—WATERFOWL AND TURKEYS.

There cannot be any doubt that waterfowl and turkeys, properly managed, are amongst the most profitable of all domestic poultry. This is evidenced by the experience of breeders and feeders in Buckinghamshire, East Anglia, Cumberland, and elsewhere. The demand for ducks, geese, and turkeys is always great, and the prices, of turkeys especially, in spite of large imports at the Christmas season, for the best qualities, are most remunerative.

*Ducks.*—Of ducks there is a considerable variety to choose from, but as a rule farmers look to one or two breeds for their supply. The first favourite is the *Aylesbury* (fig. 162), a long bodied, boat-shaped, white duck, which grows very rapidly, so that when the early markets are in view there is no other breed that can compete with it. Ducklings of this breed can be reared to four and even four and a half pounds weight at seven to eight weeks old, and if ready for the spring trade will often bring a shilling per pound, and at times even more. To do this they must be fed well and regularly, but it pays.

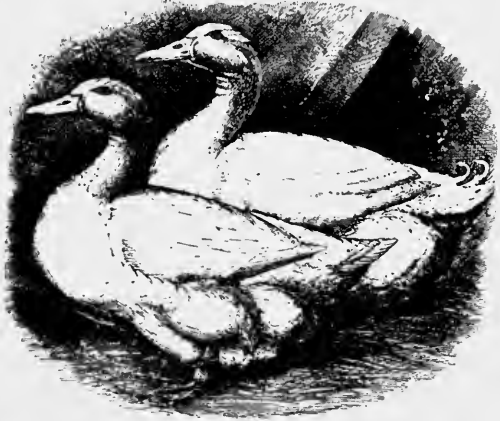


Fig. 162.—Aylesbury Ducks.

Another white plumaged duck is the *Pekin*, which has enjoyed a considerable measure of support. It is more upright in carriage than the *Aylesbury*, and carries itself like a penguin. The bill and legs are orange or yellow, whilst those of the *Aylesbury* are much paler, so that one breed can easily be distinguished from the other. It is the best layer of all the larger varieties of ducks, but has not the size of body of either the *Aylesbury* or the *Rouen*, and for that reason is not so good. Another very popular breed is the *Indian Runner*, but it is small in body, and is generally kept for its great prolificacy.

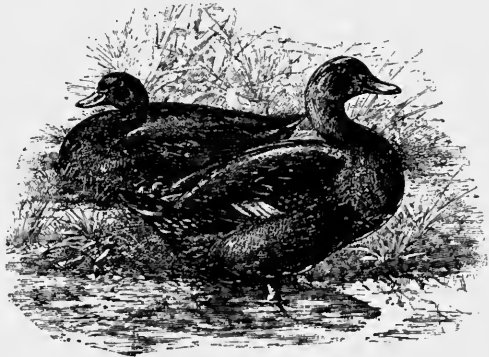


Fig. 163. Cayuga Ducks.

The *Rouen* is another valuable member of this tribe, and grows much larger than any other. But it does not mature rapidly, and consequently is not used for spring ducklings. Where fully grown ducks are in demand it is the best of all varieties, as it attains a large size, and the flesh is of excellent flavour and quality. The *Rouen* is marked like the mallard, or wild duck.

The *Cayuga* (fig. 163) is a duck which is valuable for size and

quality of flesh, but is rather dark in the meat, the plumage and legs being entirely black. It is a variety which well repays cultivation.

Though there are many other breeds of ducks, the five we have named are the best for profitable purposes, many of the others being simply fancy breeds, and therefore not within our purview.

*Geese.*—From September until after Christmas, the demand for geese is constant, and moderate prices are paid for them, more especially in the large towns and cities. It is the custom in Norfolk and Suffolk after harvest to place them on the stubbles, where they can obtain a large portion of their food, and flocks are to be met with upon most of the farms in East Anglia.<sup>1</sup> These are fed up for the Michaelmas and Christmas markets, and when properly fattened and dressed they realise moderate prices. As a rule fatteners do not

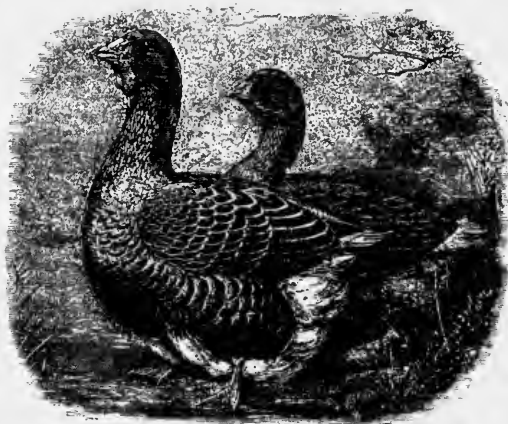


Fig. 164.—Toulouse Geese.

breed their own geese, but buy them for that purpose, though most of the farmers rear a flock or two. The goslings are purchased when quite young, and large numbers are bred by cottagers living on the borders of the commons which there abound. These are placed under stages, and fed upon barley meal, maize, wheat-tailings, and brewers' grains mixed. The first fattened are prepared for the Michaelmas markets, and their places are then taken by such as are being fed for Christmas. On turnips geese are found to be capital substitutes for sheep, and they are often used in this way, the only preparation being that the turnips are given a chop, and the geese will then eat them far cleaner than will sheep. The two breeds most commonly kept are the

<sup>1</sup> Many flocks of hundreds of geese are let to farmers in Lincolnshire, who receive the birds at about 7 weeks old, and run them on the grass, and afterwards get them nearly fat on the stubble, when they are fetched back by the hatchers, who pay the farmer half their value according to weight. The hatchers pluck the birds while on the farms, and take the feathers.



*Toulouse*, or grey, and the *Emden*, or white. Of these the former usually attains to the greater size, but is the slower grower of the two varieties. These Toulouse geese (fig. 164) are, therefore, chiefly used for Christmas time, as they do not mature sufficiently to be ready for the earlier season, when their flesh is very loose and blue. As already stated, the *Emdens* do not attain to the same weight, but are preferred where early maturity is a *sine quâ non*. A paper on "Geese and Geese-breeding," by Mr. Edward Brown, appeared in the Journal of the Royal Agricultural Society, 3rd series, vol. x., 1899, p. 313.

*Turkeys*.—Whilst the delicate nature of the turkey has been exaggerated, there can be no question that it needs favourable conditions to secure success. Like the Dorking and the French breeds of fowls it can withstand cold, but not damp, and hence it should not be kept where the soil is heavy, moist, and cold. The period of extreme

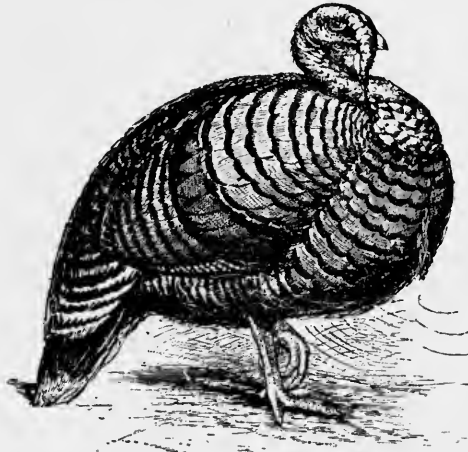


Fig. 165.—Bronze Turkey Cock.

Winner of First Prize, Dairy Show, 1890.

delicacy is when the young birds are "shooting the red," but that process once over they are hardy under favourable conditions. The varieties which have been chiefly bred in England are the *Cambridge* and the *Norfolk*. The former is bronze in its plumage, and evidently owes much of its quality to the American Bronze turkey; the latter is black. Size is so important an element in the turkey that of late there has been a considerable importation of American Bronzes (fig. 165), which grow to a great weight, often reaching over 30lb., and as a higher price per pound can be obtained for birds over 20lb. than for those under, this is an important matter. We do not care for the larger-sized birds so much as the smaller, as they have not the same flavour, but there can be no question that it is more profitable to breed the big birds. It must be remembered that turkeys do not attain their maturity before they are three years old, and no bird under two years

should be bred from. Neglect of this precaution will lead to enfeeblement, for breeding from immature stock is most injurious. In France the white turkey is largely bred, but in this country it is seldom seen. It does not attain the size of the breeds which have already been named, but is excellent in flavour of flesh, and is a very handsome fowl.

#### 5.—ORNAMENTAL POULTRY.

It is not necessary that we should enlarge upon this section of domestic fowls, because, though very beautiful or specially quaint, these fancy varieties have no economic value. They comprise the Game Bantams, of which there are at least six colours; the Bantams, of which there are about fifteen different kinds; and such breeds as the Silkies, the Sultans, the long-tailed Japanese, the Frizzled, &c. Many of these are bred largely, more especially the Bantams, and command large prices, but solely for their fancy points.

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### CHAPTER III.

#### HOUSING OF POULTRY.

**W**HATEVER be the form of poultry-house there are certain regulations which must be observed if the inmates are to be comfortable, and unless they are comfortable it is scarcely to be expected that they will thrive. These can be obtained in the smallest and in the largest houses alike—in the most simple as well as the most elaborate; in fact, the more ornate the house is the greater danger there is that these necessary matters will be neglected. Fowls are like children; they do not like to be dressed up and made to conform, as it were, to the restrictions of a drawing-room. Yet this is a mistake which is often made in an attempt to compel absolute cleanliness. In the Queen's poultry-house, at Windsor Castle, both the ornamental and the practical are secured at once. This is done by having large ornamental runs at the front, where the birds can be allowed to go when they are to be viewed; but behind are runs of a more easy-going type—virtually the living-places of the inmates, where they are not compelled to be on their best behaviour, but can disport themselves in the way that is most natural to them. Of course, for this object, there must be plenty of space at command, but such is generally the case when houses of this nature are erected.

Some breeders prefer a low to a high house for poultry, the reason being that the former is usually warmer in winter; we, however, do

not agree with this, for it is almost impossible to properly ventilate a low house. If the birds are allowed to perch at all, and this is necessary except in the case of Cochins, Brahmas, and other feather-footed exhibition birds, they will either have no ventilation provided, or will be in the direct line of the draught,—as bad an arrangement for fowls as it is for human beings. It is undoubtedly true that the low houses are usually warmer in winter than are the higher ones, simply because there is not the same space. But this additional warmth is very dearly purchased if the inmates have to breathe every night a foetid atmosphere. The great advantage of a more lofty house is that ventilation can be secured without the least need for the fowls being exposed to any draught; and, if the house is well built, we do not think that the additional space thus afforded will add seriously to the coldness of the atmosphere in the winter season: even if it does there are other ways in which this can be guarded against or provided for. Our own preference is to have the roof about three feet above the roosting perches, but if the roof be gabled it may with advantage be six or twelve inches higher than that, the object being to allow for a ventilating chamber in the roof. This is, however, a question to which we shall refer again.

The size of the house is not an easy question to settle; but for medium-sized fowls, such as Minorcas, Houdans, &c., it may be taken as a good guide that one fowl needs two square feet of floor space, that is, if the house be six feet square, and therefore covering an area of thirty-six square feet, it will comfortably accommodate eighteen fowls all through the year, but in the autumn and winter three or four more may be placed therein. If the fowls kept are of the larger breeds, then the number in a house of this size should be reduced by two, and if of the smaller varieties it can be increased. More fowls can be accommodated when, in addition to the house, there is also a covered shed attached, and this is most desirable wherever it can be managed. Fowls do not like to sleep in the same apartment as they go to for shelter when the weather is unfavourable, or for their dust-bath. A very great mistake is made by many poultry-keepers through their attempting to keep too many fowls in their houses; overcrowding never pays, and many of the diseases and troubles of domestic fowls are due to this cause. If, therefore, the space which we have advocated seems excessive, it is because of the very mistaken ideas which are prevalent on this question.

In this country it is the custom to merely give as much light as will pass through a small sky-light, or through a window let into the wall on one side; in either case the window does not exceed a foot or eighteen inches square, and it is very often about a foot by six inches. This is a mistake, and the American plan of giving a considerably greater amount of glass is the wiser one. The object of limiting the glass has arisen from the idea that it causes the house to be hot in summer and cold in winter; this is undoubtedly true, but the benefits to be derived from the using of glass more freely are so great, that it is worth while seeking to obtain these advantages while endeavouring to avoid the ill effects of either excessive heat or great

cold. One window should face the east, so placed as to catch the early morning rays of the sun, and another may be on the west side for the purpose of receiving its last beams, but the principal window should be to the south, and this one may be considerably the largest of the three. The east and west windows should be placed rather high, so as to obtain the rays of the sun to the fullest extent. It is desirable that one or more of these windows should be made to open, or wire netting used instead of glass.

In all poultry-houses it is necessary to have one large door for the use of the attendant, and a small trap-door for the exit of the

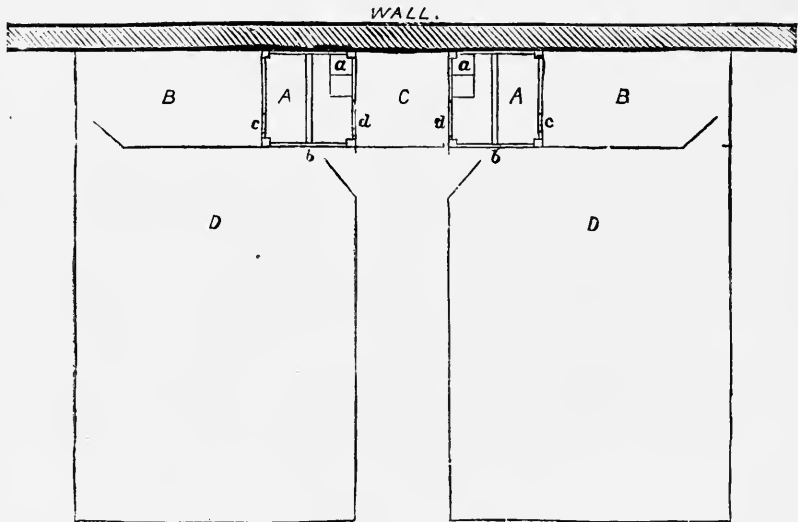


Fig. 166.—Plan of a Double Poultry house.

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| <p><i>A</i>, Roosting and laying houses, with dust-bath underneath.</p> <p><i>B</i>, Covered sheds.</p> <p><i>C</i>, Hatching house, fattening house, nursery, or chicken run.</p> | <p><i>D</i>, Grass runs or yards.</p> <p><i>a</i>, <i>a</i>, Nests with flaps opening into house <i>C</i>.</p> <p><i>b</i>, <i>b</i>, Perches.</p> <p><i>c</i>, <i>c</i>, Holes for fowls.</p> <p><i>d</i>, <i>d</i>, Doors for attendant.</p> |
|--|--|

fowls. The positions of these must in large measure depend upon the position of the house. It is, however, desirable under all circumstances, to have the latter where the inmates will not be unduly exposed to cold or draught, for if put on the windy or cold side of the homestead, it will scarcely be possible to keep the house comfortable. It is better, when a shed is attached to the roosting-place, to permit the trap to open therein, both for protection and for the convenience of the fowls. The aperture should be a foot wide, and eighteen inches high, except for the very largest breeds, when it may be two inches wider and three inches higher. It should be covered with a sliding-trap, and if there is any danger of robbers, some provision should be made so that the trap can be fastened on the inside. Two feet six inches is the usual

width for the larger door, and the better it is fitted the more protection will there be against unwelcome draughts. The plans shown in figs. 166 and 167 are excellent for permanent and fixed houses, and explain themselves.

The material of which the house should be built depends so much upon local conditions and circumstances that it is scarcely possible to recommend that which will suit all breeders. Where the poultry-keeper is landowner also, or has a certain tenure, the best thing is to use stone or brick, if either be available, for it will be found the cheapest in the long run. A well-built poultry-house has very much to do with the success of the venture. Brick and stone are both warmer than wood, and do not need so much attention when erected. They should be plastered out and kept well lime-washed; but in many

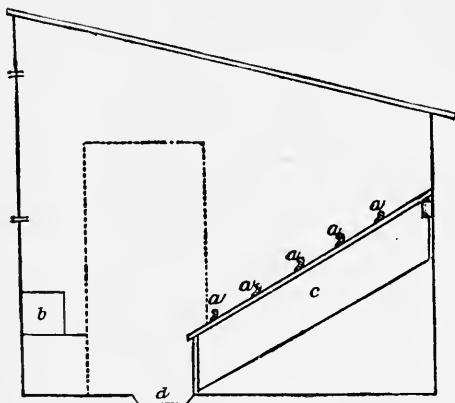


Fig. 167.—Section of an American Poultry-house.

*a*, Roosting poles.  
*b*, Laying boxes.

*c*, Slanting boards down which droppings roll into  
*d*, Gutter.

places, either because wood is much the cheapest, or for other reasons, this material is preferred, and, of course, for movable poultry-houses, it must always be used. The general mistake made is in having the deals too thin. We have always used tongue-flooring deals an inch thick, and a house so made, and well put together, will be very warm and comfortable—quite enough so, indeed, for all ordinary requirements. The advantage of using the tongued-boards is that they are less liable to allow of interstices for the entrance of air or water.

The roof can be made of various materials. On a brick or stone erection slates or tiles will look best, but they are rather expensive; they of course last well. Galvanised iron sheeting has come into use very much of late years for poultry-houses, and it is cheap, handy, and durable; but it is so susceptible to changes of temperature that, when used, the inside of the roof must be lined with wood, or the fowls will be either roasted or starved, according to the season of the year. Wood makes a good roof, but will not answer alone, and it must either

be covered with felting, or with Willesden paper, or be well tarred and sanded. We have sometimes made a very cheap roof-covering, and also used the same for the sides of wooden houses, by first tarring the wood, and then, while it was wet, laying on sheets of brown paper, tarring the whole over again two or three times. This, if each coat is allowed to dry before the next is put on, makes a most efficient covering.

Not the least important part of a poultry-house is the floor; if this be not properly made, no matter how well built the rest of the house may be, it cannot be right. A damp floor means a damp house. There is also another consideration: if the house floor be not capable of being kept sweet, the atmosphere of the house can never be pure. This is a detail in which many poultry-houses entirely fail. In process of time the floor becomes charged with the odour of the droppings, and this impregnates the air day and night. What wonder, then, if the fowls do not thrive, and if they take all manner of diseases unaccountably? The floor we like best of all is peat-moss litter, or dry sand. The ground should be dug out to the depth of eighteen inches, and half filled in with coarse gravel, or burnt brick-ballast, or small stones, well beaten down; above this the litter or sand is placed, and it can be raked over daily, and renewed every six months, or when needed. Failing this, the best floor is made by having the layer below as already stated, but instead of the sand a compost should be prepared of cinder-ashes, fine gravel, quicklime, and water, well mixed together, and spread. When hardened, this makes a first-class floor. Cement is far too cold, and bricks absorb the moisture from the droppings, so that neither of these materials should be used. It is desirable that the floor inside the house be higher than the ground without, for, if lower, it will certainly be damp.

The form of houses adopted for poultry has changed very greatly during the last few years, as a result of study of the conditions under which birds can be kept most healthily, and is also due to the wide experience gained by a multitude of poultry-keepers. Things are very different indeed from what was the case in the old days, when birds were accommodated in one of the farm buildings, or a great number of smaller poultry-keepers erected buildings for this purpose on crude and unscientific lines. It cannot be forgotten that hygienic principles should be applied to poultry houses to the same extent as to human dwellings, and that neglect on that score will bring about disease in one case just as much as in the other. In saying this we are not advocating elaborate and expensive structures, but rather buildings which conform to the requirements of the inmates, and enable them to live under what must be regarded as artificial conditions of life with the greatest chance of profit and health.

One of the first developments which took place a few years ago was the adoption of wooden houses of a portable character. Theoretically, of course, every writer upon poultry has advocated sufficient ventilation, but in practice this has not been secured. We have only to examine the greater number of houses, both those made by poultry-keepers and such

as are sold by appliance manufacturers, to see that the provision for ventilation is insufficient, and fails to secure that change of atmosphere which is absolutely requisite for the health of the inmates. This can scarcely be avoided when houses are built solid all round, and with only a few ventilation holes or louvre boards in the apex of the gables. The result of this has undoubtedly been to increase the productiveness of the birds up to a given point, but with that, and enhanced by other influences, such as high feeding, &c., the tendency has been to reduce their natural vigour, and consequently after a period—long or short in accordance with the conditions—there was a falling off both in stamina and in egg production. Our attention has been especially called to this matter by the latest investigations in reference to consumption in the human subject, from which it is evident that a great amount of tuberculosis, which takes several forms, is due to impure atmosphere. We need not go into the details of observations which have led to this



Fig. 168.—Portable Poultry-house.

conclusion, but that much may be accepted as a matter of fact, and for the last few years a good deal of attention has been given to this side, with a view of discovering how far such disease can be avoided by what may be termed a more natural method of housing. In connection with this it was necessary to be prepared for the result that with a greater amount of exposure to the outside atmosphere there may be a falling off in the production of eggs, but it is satisfactory to say that this has not proved to be the case; in fact, in some of the houses under observation the result has shown that healthy birds will frequently lay better in the open-fronted houses than they do in the smaller close buildings of the older type. For farmers the best form of house is one that is portable and can be easily moved from place to place in accordance with the rotation of the farm work (fig. 168). These houses should be placed upon wheels and, naturally, should not be too large in size, otherwise they are heavy to move. The best size is either 5 ft. square or 5 ft. by 6 ft.

As, however, houses of this kind, being raised above the ground, must have a wooden floor, it is found that they are colder in winter than where the ground is the floor. To meet this difficulty, arrangements have been made to dispense with the floor by means of a lever arrangement, so that the house can be raised on wheels for removal, and then dropped down after that has taken place. In this way there is a great saving of labour so far as cleaning is concerned, as the ground forms the floor and the manure falls on to it, and is simply left when the house is changed from one place to another. In this way the manure is utilised without any labour, and a great improvement in the crops results. If portable houses are used in districts where foxes are preserved, it is frequently necessary to have a fitted run, so that the birds may be protected against these enemies. By the adoption of such



Fig. 169.—Fixed Poultry-house.

a plan the birds are shut in at feeding time in the afternoon, allowed to go to roost when they think fit, and in the morning they can come out of the house as soon as they like.

In many cases, however, it is desirable to have fixed houses, and where that is the case larger buildings are to be recommended, and here what is called the open-fronted house is found to give the best results (fig. 169). There is, however, one important point to keep in view, namely, that an open-fronted house must necessarily be larger than one of the former type, and thus they are less suited for portable structures, although we have found that the latter can be so arranged as to ensure a plentiful supply of ventilation. In the fixed houses it is desirable to provide not only for the roosting and laying portions, but also to give a considerable amount of space to what may be utilised as a scratching



shed, or at any rate, as a cover for the fowls. We do not think that it would be desirable in a small house to have one side entirely open, because under those circumstances the birds would be too much exposed.

In connection with the College Poultry Farm, Theale, a range of houses has been erected, which embody the latest experience in this direction. These houses are built separately, and are of a substantial character, but erected in sections so that they can be removed if necessary. Each house is 10 ft. square, 7 ft. in height at the front, falling to 5 ft. 6 in. at the back. They are solid back and ends, and have a substantial roof, which is made of thin matchboarding, covered with felt and corrugated iron on top. The front of the house is composed almost entirely of wire netting, which is kept uncovered all the time. The only exception is that we have a curtain of coarse canvas inside, which can be let down in wet or snowy weather. The result is that the birds have a plentiful supply of fresh air, although they are effectively sheltered against extreme cold and driving rain, but can in



Fig. 170.—Cottager's Poultry-house.

no sense be subjected to a lack of oxygen, which is apparently the result of keeping them in the ordinary form of smaller poultry-house. The lower 2 ft. of the front is boarded, although that makes no difference to the principle, and in this are placed food troughs, hinged, so that the birds can be fed either inside or outside. There is a shutter on the higher part of the front, simply for the purpose of preventing rain driving inside. The internal arrangements are that at the back is a laying compartment, 3 ft. square, into which the birds enter by a small trap, and, of course, there is a larger door. The object of this is that if we were wishful to what is called trap-nest the birds, that is, test individual laying, arrangements can be made for that purpose. The perches are placed at the back of the house between the end of one wall and the side of the laying compartment. Thus the fowls roosting upon the perches, of which there are two, are not within 6 ft. of the front of the house. There is a door for entrance at one side, and also in front.

The above form of house is capable of accommodating anything up to twenty birds, and is designed for the purpose of ensuring the health of

the inmates, and at the same time avoiding anything which is conducive to disease, more especially as a result of tainted atmosphere, and of thus protecting the inmates from what is becoming a very serious question to poultry-keepers in this country. Such a house as the above costs a little more than the ordinary form, but if any one is willing to build his own, they can make one of these houses of good material, say inch boards, including the wire netting and corrugated iron, at an expenditure of not more than £2. 10s. to £3 for materials, and in some cases the expense need not be quite as much as this. If it were built on a frame, not intended to be taken to pieces, something like 5s. to 7s. 6d. could be saved. The house is placed upon gravel, and, of course, to each there is an enclosed grass run.

CHAPTER IV.

HATCHING AND BREEDING.

**T**WO conditions are absolutely necessary in the hatching of a fowl's egg, namely, heat and moisture. Without heat the germ of life contained within the shell, its envelope, would never develop, but would die from inanition. Without moisture the absorption by the outer air of the moisture within the shell, would be so great that the chicken, if it remained alive until the time of hatching, would find itself surrounded by a tough shell and a tougher membrane, through which it would be utterly unable to penetrate. Whether the chick ever reaches this stage or not depends upon the dryness of the atmosphere by which it is surrounded, for if the absorption be too great, then the embryo will die at an earlier stage.

It is important to bear in mind that the egg is the method designed

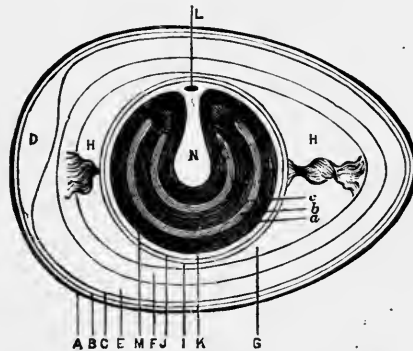


Fig. 171.—Section of Hen's Egg.

by nature for the protection of the embryo, which, in the case of birds, passes through the stages of development outside the body of the mother. In the case of nearly all birds the final stage, after the laying of the egg, is due to the attention and care of the parents, who incubate by heat from their own bodies. A hen's egg has been very expressively described by Mr. Matthieu Williams as "a sermon and a miracle, for though scientists can tell us the component parts of our morning egg, they have never been able to say why from one comes a 'little rid hin,' and from another a bantam." It is formed of several parts, which may (fig. 171) be briefly described as follows:—

A, the shell—composed of carbonate of lime, phosphate of lime, and animal glutin;

B, the outer membrane, adhering to the shell;

c, the second membrane, slightly attached to B, except at the large end of the egg, where they separate and form

D, the air space ;

E, the albuminous portion, or white, of the egg, in three layers—first, liquid ; second, semi-liquid ; and third, the inner white ;

F, the chalazæ, two twisted cords of denser albumin, taking the

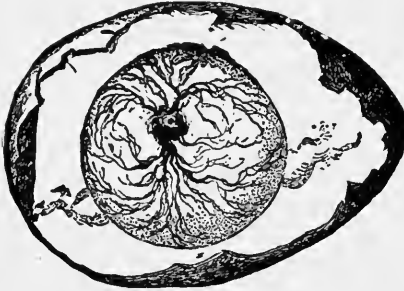


Fig. 172.—Development of Chicken—  
Third Day.

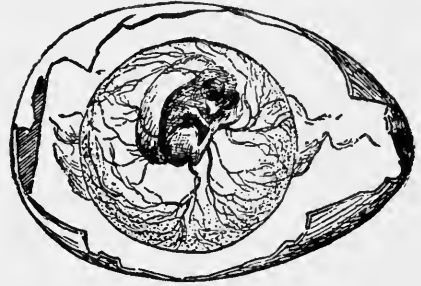


Fig. 173.—Development of Chicken—  
Seventh Day.

form of a spiral in the direction of the longer axis of the egg, and forming a ligament by means of which the yolk remains suspended in the midst of the albumin ;

G, H, I, the membranes of the yolk ;

J, the yolk, which is the richest part of the whole egg, being composed of albuminous matters, organic salts, of vitelline, of colouring matters,

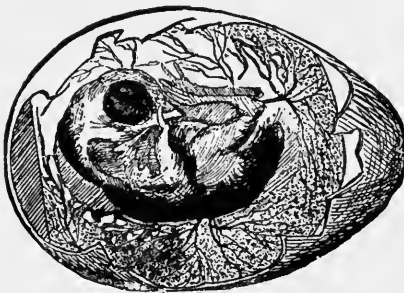


Fig. 174.—Development of Chicken—  
Twelfth Day.

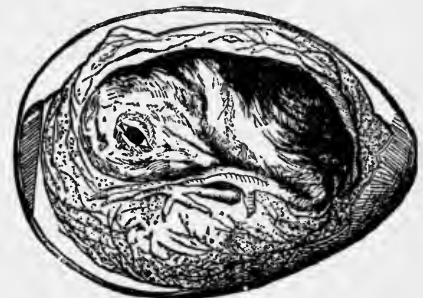


Fig. 175.—Development of Chicken—  
Fifteenth Day.

of phosphoric acid, and of a fatty phosphoric substance. From it the embryo derives its sustenance during the process of incubation ;

K, the utricule, wherein is the germinal vesicle ;

L, the germ, known from its yellowish white colour.

It has been already stated that the two conditions needed for the development of the chicken are heat and moisture. But it is important here to state that there must be the germ of life within the egg. Heat and moisture would have no effect upon an unfertilised egg, and the

germ of the male bird must fertilise that of the female, ere can arise the new existence which every life represents. A fertilised egg is subject to many contingencies, and may never hatch, but there is, at least, the possibility, which does not exist in the unfertilised egg. Here it may be well to mention that an unfertilised egg will not become rotten, and in hatching it is desirable to remember that should an egg prove rotten there has been life, but that death has occurred at an early stage of development. An infertile egg becomes stale, but that is all.

The process of development which the chicken undergoes within the shell must be very briefly summarised, but the illustrations (figs. 172 to 176) will indicate some of the stages.

First day—Germ begins to expand ;

Second day—Germ expanded still more, and veins formed ;

Third day—Brain and eye take definite form, and blood veins become thicker and more definite (fig. 172) ;

Fourth day—There appears a respiratory membrane called the

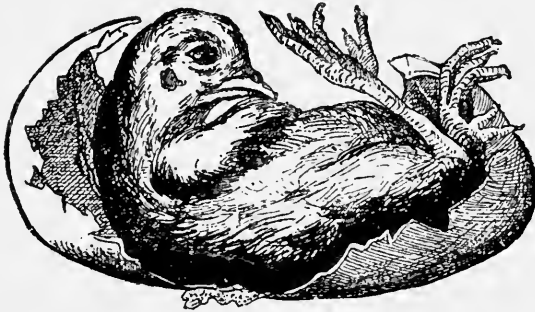


Fig. 176.—Development of Chicken—Exit from the Shell.

allantois, which, lining the shell, temporarily provides for the supply of oxygen to the blood ;

Seventh day—By this time the internal organs, including the heart, liver, kidneys, &c., have assumed their definite shape (fig. 173) ;

Tenth day—Bones begin to assume a decided consistency, and scales, legs, and feathers, may be seen ;

Twelfth day—The living organism begins to give out heat, showing that the heart is performing its work, and the blood becoming richer (fig. 174). From this time onward the chick begins to grow in size ; at the

Fifteenth day filling about two-thirds of the shell (fig. 175), and so it continues to progress until about the

Twenty-first day, when (fig. 176) it bursts its envelope and emerges therefrom, the yolk bag having been absorbed into the body a few hours previously.

The selection of birds for breeding is a very important matter, more important than is generally supposed, for parents impress upon their

offspring their own characteristics. Good points are reproduced, and if the breeding has been carefully directed these are probably improved upon, but bad points are also reproduced, and are liable to be aggravated unless great care is taken. By skill and knowledge the former can be increased and the latter diminished, if not altogether removed, but it must be borne in mind that the bad qualities are apt to return if vigilance is relaxed. The poultry breeder needs to have a clear idea of the object he is aiming at, and must ever keep that end in view. Those who have high-class exhibition poultry are most particular regarding the choice of stock birds, and will take an amount of trouble which would be regarded as unnecessary by those who are unaware of the importance of the matter. The result of years of careful breeding may be upset by one injudicious cross, and though our readers need not be so particular as those who breed merely for feather, yet it is necessary to exercise considerable thought. It would be foolish indeed to spoil a good strain for want of a little forethought and trouble.

Each of the sexes has a certain and defined influence upon the offspring, and knowing this we have a guide to enable us to select the birds we require. The male parent affects the external structure, shape, outward characteristics, and movements of the bird, whilst the female parent controls the internal structure, the constitution, the temper, the fecundity, and the habits. Here are well-defined lines upon which to proceed. The question is often asked as to the relative value of pure *versus* cross-bred stock. Our reply to this is the following quotation from an admirable article by Mr. L. C. Norris-Elye, which appeared in the "Live Stock Journal Almanack":—

"It must be remembered that man's selections will be for external characteristics. Meanwhile, nature is dealing with internal organs, constitution, &c., so that both may combine to produce characteristics more useful to man in the position in which he keeps them, and man's work may indirectly affect these internal characters by the selection he makes, and the treatment he gives his animals. In some cases the zeal for beauty, or what the breeder considers beauty, may result in temporary loss of some useful quality, if not entirely, yet in some degree. Now it may be that selections of some breeds of fowls for certain points of beauty have somewhat led to the neglect of their laying qualities, as the parents had not been selected for laying for many generations. Still the capacity is rather dormant than destroyed, and if it be wished to select for egg-laying capacity a high productiveness could no doubt be soon attained. Pure breeding, therefore, simply means careful, long-continued selection, with a defined object in view, and carried on skilfully and carefully with a knowledge of the principal laws of breeding, and without having recourse to raw crosses of other strains.

"If we reject pure breeding, we have no hope of improving our breeds, whether of horses, cattle, sheep, pigs, dogs, fowls, pigeons, &c. We are content to stay as we are, wanting nothing better. This lethargic condition of mind is certainly not the characteristic of the English

race, who have long stood at the head of the skilled breeders of the world, and for whose stock enormous prices have long been, and still are being, paid by those in other countries who wish to improve their breeds. When England ceases to produce the skilled breeders of the world, the national characteristics of dogged perseverance, determination not to be beaten, and hard-headed skill will be already dying out, and other signs will be visible that the England of the period is a poorer and feebler England than that in which I have the happiness to write."

We have said that the male parent influences the external structure and characteristics, as well as the shape of the bird. The first thing, therefore, is to see that the cock selected for breeding purposes shall have size, and by this we mean size of frame, not merely fat and feathers. A fat bird is seldom a good breeder, and there is many a fluffy-feathered one that appears to be of a large size, which, when taken in the hand, is found to be very light. A small bird will never produce large ones, and hence the importance of the point. The bird should also be examined to see if there are any grave defects, such as deformity in its body or limbs, or the possession of any characteristics that are regarded as blemishes in the special variety to which it belongs. However good a bird might be in other respects, it would be very foolish to select a bird so affected, as it would transmit its fault, and probably in an intensified form, to its descendants. It may, therefore, be taken as a rule that the bird which is shapely, of good size, and looks best, is really the most suited for breeding purposes. Many birds with defects such as we have referred to are of no use for laying or for table purposes; but, if bred from, these defects will not only be perpetuated, but so intensified that it will be very difficult to get rid of them. Some breeds of fowls, which at one time were amongst the most useful of our domestic poultry, have been completely ruined by fanciers, who have seized upon some one point, it may be an actual defect, and by breeding for it have weakened the really good qualities. In choosing a cock to breed layers, we should select a bird firm and close in body, of good size, though not abnormally big, clean and tall on leg, and active in its habits; whilst for the production of birds for table purposes, it is better to pick one heavy in body, shortish on the leg, deep in the breast, and not very active.

The hen, as we saw before, affects the internal structure and the vital organs. Thus it will be found that a good layer will produce good layers, a good mother good mothers, and a ready fattener those most suitable for table purposes, if—and the "if" is an important item in the calculation—the male bird be selected accordingly. With respect to hens, the same thing applies to the selection of shapely, well-made, and good-sized birds, for though a hen may have a fault in the organs or characters which she does not influence so much as the cock, yet that defect will almost certainly be transmitted to a greater or less degree, so that the choosing of a good bird is very essential. For producing layers those birds known as good layers should alone be bred from, and it is better to use non-sitting birds such as Minorcas, Leg-

horns, Andalusians, or Houdans, as these breeds can give their undivided attention to laying. For mothers, the chief requirements are a quiet even temperament and size, so as to cover a good number of eggs, but, of course, these birds must be of the sitting breeds. For table purposes, they should be of a quiet contented nature, and similar in appearance to the male bird as described above. We need scarcely add that no bird with the slightest sign of disease or hereditary complaint should ever be bred from. Stamina and good condition are, perhaps, of equal importance to anything else in a breeding fowl, and it is courting failure to neglect them. Consanguinity is also to be guarded against, as breeding-in soon debilitates and reduces size in the birds.

Where there are to be only two or three batches of eggs hatched during the season, there need not be much difficulty in providing for them. A hen can be set in some quiet outhouse, or shed, where incubation will probably go on without any trouble. In this case, if the house or shed can be given up to the hen entirely, it will be best to provide a square box without a bottom, which, standing either upon the earth, if the floor be of that material, or upon sand or earth, if it has an artificial floor, will be the simplest and easiest thing. This box is best if it is made to completely cover the hen, but without a front, so that the hen can leave the nest whenever she wishes so to do. The advantage of a hatching-box like this over a square, open-topped box, is that moisture can be given to the earth below during a very dry season without disturbing or alarming the hen. If it is thought desirable, such a box can be made with a door in front, so that, if necessity should arise, the hen can be shut in her box.

As we shall have occasion to refer to the hatching-box which we have used so successfully, it will be well to give a description of it. It consists of a box without bottom, and, for ordinary-sized fowls, is made about fifteen inches square, and eighteen or twenty inches high. The material, wood of course, is half or three-quarter inch boards, and it is built with solid back, sides, and top. The upper part of the front forms the door, which is the width of the box, and fifteen inches high. A piece of deal three or five inches in depth, according to the height of the box, forms the lower section of this front; or, if a twenty-inch high box, the bottom piece may be three inches, and a piece two inches wide fixed at the top of the front. The loose piece is made the door, and is hinged at the bottom, fastening to the top by a button. When this door is open it falls downwards, and thus provides a firm footing for the hen in entering or leaving the nest. Where hens are set by themselves the door may be dispensed with, but as the cost of adding it is so slight we should recommend that it be added. Three ventilation holes should be made in each of the sides and in the back, quite close to the top, and half a dozen in the top, where a handle can be fitted; but of course these are only needed if there is a door attached to the box.

There are several appliance-makers, including Spratts Patent, to whom we are indebted for the illustration (fig. 177), who sell hatching-boxes, but their boxes have a frame with wire-netting stretched across



for the door, which also opens upwards, and we do not, therefore, like them so well as our own. But one or two of these boxes have netting stretched across the bottom as a protection against rats, and this is a very necessary precaution where these pests are troublesome. Such a box as this can be used anywhere, whether one hen or a score of hens are set in the same place, and they can also be utilised as laying-boxes when the hatching season is over.

In those places where only a few hens are to be set we should advise that, later on in the year (except in unusually severe seasons), say, after the early part of May, the hens have their nests made out in the open. Of course, some shelter will be necessary, but if one of the hatching-boxes be used, all that will be required will be either a rough covering or a coop, or the hen can be set in a coop, and then will not need to be disturbed when her chickens come out. On farms there are often sheds scattered about which can also be utilised. One of the difficulties of this plan, at least in many parts of England, is that foxes are preserved, and help themselves, as is their wont, to the poultry. And we suppose the same complaint can be made as to other animals in every part of the world. These matters must be dealt with according to the local conditions, and, whilst it would be wise to adopt the outside plan where the conditions permit, yet if foxes and other predatory animals abound the hatching had better take place where the hens and chickens can be protected.

Perhaps one of the best plans for those who have large farms,—and we have seen it adopted in several places,—is to put the hatching in charge of some of the labourers, so that they can raise the chickens near their residences. The usual plan is to pay them a specified sum per bird hatched and reared to a given age. In this way the cordial co-operation of those taking charge of setting hens is secured. This applies only to those who practice poultry-keeping on a large scale, but, if poultry are to be made to pay, it is desirable that the attendants should have some direct interest in their success. However slight this interest may be it will prove a stimulus to greater care and effort, and far more than repay the outlay involved.

The advantages of the plan we have been recommending are that there can be no fighting amongst the hens, which often takes place when they can see each other, causing breakage of eggs, and great annoyance as well as disappointment to the owner. Then the saving of trouble is great, as all the hens can be set in one room, which, of course, could not be done unless they were completely shut up. The proper airing of the eggs is also secured, and the sitters can be allowed off the nests by turns at the convenience of the attendant; and also, as we shall see presently, the progress of the eggs can be easily

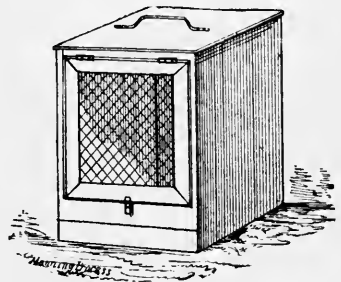


Fig 177.—Hatching Box.

noticed, and several of the accidents to which they are subject remedied at once.

The object in having soil or ashes at the bottom of the hatching-box is to provide moisture, so important to successful hatching. A hen selecting her own nest generally chooses a damp spot, and in doing so recognises by her instinct the requirements of her expected brood. Without moisture, the shell, in the first place, becomes hard and dry, so that if the chick lives, it is unable to break through the shell; but generally we find that the bird itself dies before it reaches maturity. Many failures in hatching arise from setting the eggs upon wood, brick, stone, or cement floors, where no moisture can be found, and the hen, in her state of fever, not only cannot supply this to the eggs, but actually draws from them, with the result indicated. The soil or ashes do not of themselves contain sufficient moisture, but by their assistance we can make up for the deficiency in a very simple and easy manner, namely, by pouring a small quantity of warm water round the outside of the box, which, communicating with that in the box, keeps the whole reasonably moist.

Some breeders make a great mistake in the way they use the water; they have got hold of the right idea, but apply it in the wrong way, for they pour the water over the eggs. Now this is in the first place unnecessary, for the heat of the hen draws the moisture from the soil, and gently communicates it to the eggs. But in the second place it is absolutely dangerous, and that in two ways. Eggs rot when laid in water, and there is always a danger of putting too much on the eggs, for the soil, if already charged with moisture, does not absorb it, and consequently they lie in water for a short time. Then, again, during severe frosts, an egg-shell will contract and crack if water be put upon it; but by the plan we have spoken of, all danger of this kind is obviated, and just the quantity of water which the eggs require communicates itself to them. Of course, during cold weather, the water does not evaporate so rapidly as in warm weather, and the quantity given must be regulated accordingly.

Hens, in a general way, should not be disturbed whilst sitting, so long as they come regularly off the nests. Still, an examination of each nest can be made every day or two, to see that no eggs are broken, or the nest spoiled in any way. If any such casualty has taken place get a pail three parts full of water, heated to about 103° F., or as warm as the hand can tolerate comfortably, place in it all the whole eggs, re-make the nest, and, after cleaning the eggs, return them to it. Before the hen is permitted to go on again, she should be washed on the breast, and between the thighs, as any sticky substance adhering may cause a similar catastrophe again.

A word or two about the selection of eggs for sitting purposes is required, because there are breeders who think that the largest eggs produce the largest chicks, and consequently always select these for hatching. This is, however, a mistaken idea, and the proper rule to follow is, that very large or very small eggs, and those misshapen or at all abnormal, should be rejected. Very large eggs are often double-yolked,

and misshapen ones are either infertile or produce monstrosities. The only safe way is to select fair-sized, even-shelled eggs. These, if fertile, and well sat on, may be expected to hatch satisfactorily, and we have often known such eggs, sent to or received from America, produce 75 per cent. of chickens. It may be accepted, also, that eggs are better set as soon as possible after they are laid, but for obvious reasons this is not always practicable; and, if kept in bran, small end up, and turned over every day or two, we should have no fear in setting them when a month old. The fact we have just mentioned respecting those sent to America is proof enough of this.

But the packing and carriage of eggs have a very great deal to do with their success in hatching. If they have to be transported in any way, the best plan is to get a basket or hamper, and cover the bottom and line the sides with soft hay; first wrap every egg separately in soft paper, and then with fine hay or dry moss, and pack them in the basket so that they will be kept firmly in position. They will thus travel hundreds or thousands of miles, and bear more than a reasonable amount of knocking about in perfect safety, for the whole is of a springy nature, and a jerk is almost impossible. Eggs can, of course, be packed in boxes the same way, but there is no elasticity in these, and when put



Fig. 178.—Egg Box.



Fig. 179.—Egg Box with Wood Wool Packing.

down at all roughly there is the sudden jerk we have spoken of. Packing with sawdust or bran in a wooden box is ridiculous, and if we were purchasing eggs we should refuse to accept them if sent in that way. In this context it is only right, however, to mention that several patent egg-boxes have been introduced which are admirable in their arrange-

ments for the prevention of jarring, which is so destructive to the embryo. Those made by Messrs. Freeth & Pocock, of London (fig. 178), are among the best we have yet seen, and fig. 179 represents a box in which layers of wood wool or hay are used, made at the *Depôt* of the National Poultry Organisation Society, Glastonbury.

When it is intended to set several hens it is preferable to give them their nests two at a time, and if it be found on the seventh day when they are examined that about half of each setting are infertile, all can be placed under one hen, and the other hen given a fresh nest. Some old-fashioned people do not believe in examining the eggs, but we never yet heard a convincing argument against the practice, and the advantages are obvious. No harm can be done to the eggs; those infertile are saved either for culinary purposes—for which they are quite good—or for feeding the young chicks, and, as we have shown, the energies of the hens are not wasted by sitting on barren eggs.

The process of testing eggs is a very simple one. When the hen is off the nest remove the eggs into a dark room or closet, in which a lamp or candle is placed. Take the egg in the left hand, holding it between the first finger and the thumb, and shading off the light from the eyes by the right hand. If the egg is then brought in a direct line between the eyes and the light, and about six inches in front of the latter, its fertility or otherwise will be at once detected. A barren egg at the sixth or seventh day will be perfectly clear, except a very slight shadow like a thumb-mark in the centre; whereas a "live" egg will be opaque—very black in the centre, gradually getting somewhat transparent towards the edges. The former should be kept out, and the latter returned to the nest, and the poultry-keeper need have no doubt as to his judgment in the matter if our directions are followed, as a clear egg is very easily known, and can never contain a chick, no matter how long it may be sat upon. Some people use a piece of thick cardboard, with a hole about the size of an egg cut in the centre, and this is very effective, as the light can only pass through the egg to the eye. There are also egg testers, sold at reasonable prices, which are excellent; one of these made by the Jersey Co., is illustrated in fig. 180. By means of the cardboard or the egg-tester an egg can be tried by day when the light is admitted into the apartment by one small window. But though the method is not of great moment, we strongly urge breeders to examine their eggs on the seventh day. It is quite possible to tell whether an egg is fertile about 48 hours after sitting commences, but this needs considerable experience, and should only be resorted to by those who have incubators. For all practical purposes, the time we have mentioned is the best. Testing is particularly desirable when the sitting of eggs has been obtained from an outside source, and the poultry-keeper has no knowledge of the degree of carefulness exercised for insuring that they are fertile. It often happens that sittings for which high prices have been paid fail to yield a fair number of chicks, and sometimes they prove almost entirely barren.

After this examination has taken place the eggs need not be looked at

again, except so far as we have indicated, until the nineteenth day, when they can be further examined, but in a different way. Get a pail and nearly fill it with water heated to 103° F., into which the eggs are to be put. Those which contain live chicks will float on the top, and soon begin to dance about in the water in a peculiar manner, the movements being caused by the efforts of the inmate to get out of its prison, and the vigour of the same largely representing the strength of the chick. Those eggs which sink or do not move at all (be sure of this latter) may be regarded as dead. After allowing the others to remain in the water about ten minutes they should be returned, wet as they are, to the nest, and if the eggs have been fresh, some may be expected to hatch out, or at any rate to be chipped, by the next feeding time. The advantage of the water test is that "live" eggs do not become crowded by dead ones, whilst the water undoubtedly softens the shell and makes more easy the escape of the little prisoner.

The question of artificial incubation has fascinated many minds. The stories of the egg ovens of China and Egypt are too well known to require recapitulation, and many have been the attempts to provide a machine which would dispense with the services of the hen. Some were excellent, others were either too elaborate or too cumbersome; but within the last dozen years or so there have been introduced several appliances which are at once reliable and inexpensive. At first sight the work of hatching by artificial means appears so simple, that it is small wonder many methods have been introduced. But it took a long series of years, and involved many failures, before the difficulties in the way of securing regular temperature, fresh air, and moisture were solved. A machine cannot think—it is unlike the hen in that it has no instinct, and thus every difficulty has to be provided for, every need anticipated. But if we get a perfect machine it will go like clockwork. The point to be asked is, are incubators of any practical value? To this we should unhesitatingly answer, Yes, where there is a sufficient number of eggs hatched to justify the cost. An incubator for fifty eggs can do the work of four hens at one time; but if we consider that it is ready to act all the year round, without any cessation, it is equal to at least sixty hens.

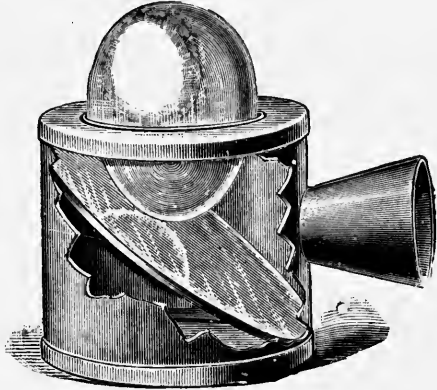


Fig. 180.—Egg-tester.

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Fig. 181.—Hearson's Incubator.

It will do its work as well in winter as in summer, if placed under favourable conditions, and will respond to the wishes of the breeder in a way that a hen will seldom do. But it is only a machine. The brains are not there. They must be in the inventor and the maker, and also in the operator. Given a good machine, in intelligent hands, and it is an invaluable assistant. We are strongly of opinion that the best place in which to put a machine of this kind is a room where

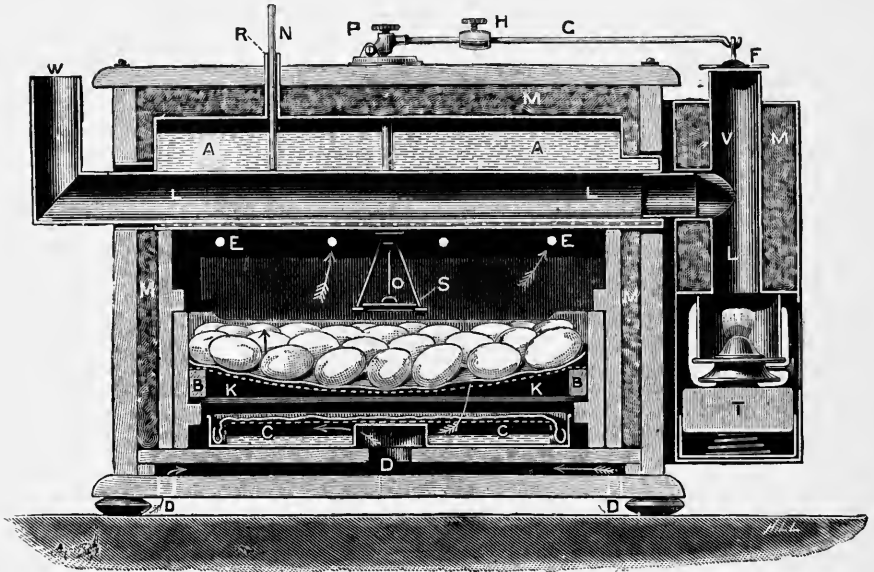


Fig. 182.—Section of Hearson's Incubator.

- A A. Tank of water.
- B B. Movable egg tray.
- C C. Water tray.
- D D D. Holes for fresh air.
- E E. Ventilating holes.
- F. Damper.
- G. Lever.
- H. Lead weight.
- K K. Slips of wood.
- L L L. Lamp chimney and flue pipe.
- M M M. Non-conducting material.

- N. Tank thermometer.
- O. Needle for communicating the expansion of the capsule s to the lever g.
- P. Milled head screw.
- R. Filling tube.
- S. Thermostatic capsule.
- T. Petroleum lamp.
- V. Chimney for discharge of surplus heat.
- w. Do. for discharge of residual products of combustion.

The overflow tube is the upper one, situated at the right hand side of the Incubator, and the lower tube is for emptying the tank.

the temperature will be uniform, as then there is less stress on the incubator. A machine which has attained a great amount of success is the "Champion," made by Messrs. Charles Hearson & Co., Limited, of Regent St., London, W. (fig. 181). It is very simple to work, and is fitted with one of the most delicate regulators that we have seen. This machine has often hatched ninety and even ninety-five per cent. of fertile eggs, and is very ornamental. Fig. 182 is drawn to a larger scale, and shows the methods of heating, regulating, and ventilating.

Other appliances are the "Tamlin" and the "Cyphers," the latter on the hot-air principle, and these have attained great popularity. They are well made, and many of those who have used them speak in the highest terms of their capabilities. There are other machines sold, but of them we are unable to speak with the same degree of confidence.

The periods of hatching are as follows:—

Fowls	.	.	.	.	.	21 days.
Ducks	.	.	.	.	.	28 do.
Turkeys	.	.	.	.	.	28 do.
Geese	.	.	.	.	.	30 do.

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## CHAPTER V.

### THE REARING OF CHICKENS.

IN the preceding chapter we advised the testing of eggs by water on the nineteenth day, after which the nest should not be disturbed for twenty-four hours, when, if the eggs were fresh when sat upon, many of the chicks will be hatched out and the rest of the eggs chipped; in fact, hundreds often hatch on the nineteenth day, and they should be dealt with accordingly. If any of the eggs are very late in hatching, remove the chicks already dry, put them in a basket near the fire with some warm flannel both above and below them, and return them to the nest as soon as the rest are out. Great care is necessary if the hen is a young or impatient one, for a fowl of this kind often attempts to hurry the process, and we have known a whole batch spoilt by the hen pecking at and breaking the shells. This confirms our previous remarks that only a two year-old hen should be trusted with valuable or early eggs. Of course, the young hens must learn how to hatch, but they need not have a nest until later in the season.

By a provision of Nature, the yolk-bag, which is absorbed into the stomach of the chick just previous to its being hatched, gives all the food necessary for the first day, and, therefore, no attempt should be made to force food upon it. Here we desire to protest against two ideas which often prevail in country-places, one of which is foolish and the other barbarous. These are, first, that a pepper-corn should always be given to the chick as soon as it is dry. We have never yet been able to realise why this is done, and those who practise it simply do so because they have been told that it is beneficial. We are almost inclined to think it is directly injurious, for the pungent pepper cannot be suitable as the first food which the delicate

stomach receives. The second idea is that the hard, horny substance found on the beak, provided to enable the chick to break its way through the shell, should be taken off by the nail and the bird made to swallow it. Only a foolish superstition could have originated such a practice; and if patience is exercised this scale comes off naturally in a few days.

As has been already mentioned, neither the hen nor the chicks should be disturbed for at least twenty-four hours after hatching except to give the former a feed, but the chicks will be all the better if they have nothing to eat for thirty-six hours, by which time a coop should be prepared for the hen and her brood. A great mistake is made by poultry-keepers in removing the chickens from the place of hatching, whether that be by means of a hen or an incubator, until they have got

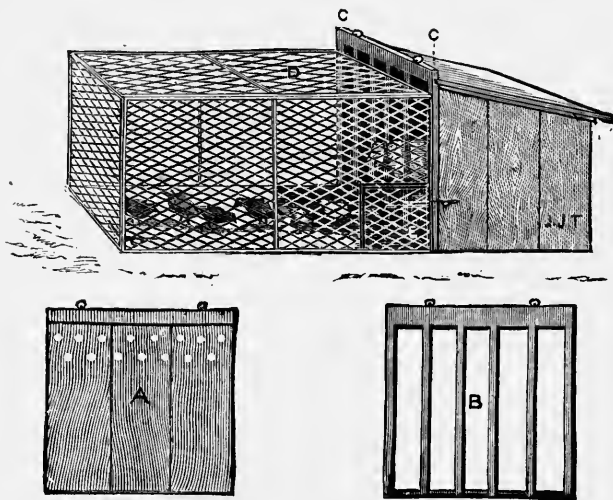


Fig. 183.—Chicken Coop.

well upon their feet. This makes a great deal of difference to their after success, and in some cases it has been found that forty-eight to sixty hours is all the better to leave them undisturbed. Coops of all kinds, shapes, and sizes are now sold by the various appliance makers, and they can be made from almost anything. Boxes or barrels are capable of being used as coops with very little alteration, and a very cheap form is a Tate's sugar box altered so that it is comfortable and protects the inmates. In front there should be bars or laths to permit the egress of the chickens, but not of the hen, and almost any one who has a slight knowledge of joinery can make a very good coop in this way. The best size is from 18 to 24 in. square, and about the same in height. It is a desirable plan to have a small run in front so that during the first few days when the chickens come out they cannot wander far, but that need not be used beyond the first week or ten days. A very useful form of



coop, especially for winter work, is that shown in fig. 185, which is really a double coop, but it is better to make the front and the partition between the coop proper and the covered run of bars, and not solid as in the illustration.

The object of the coop is to protect the inmates, and keep them dry, therefore the top may be gabled or a simple lean-to. Whether the coop shall have a floor or not depends upon the nature of the soil. If dry, it is a great deal better to dispense with a wooden floor, because the



Fig. 184.—Chicken Coop.

inmates will be much warmer than if there is wood between the ground and themselves. On heavy or damp land a floor is necessary, but in that case it should be raised up so that the wood shall not rest upon the earth itself. Two important points are that coops shall be regularly removed on to fresh ground, and that absolute cleanliness shall be observed. When the chickens are about a week old, if there is plenty

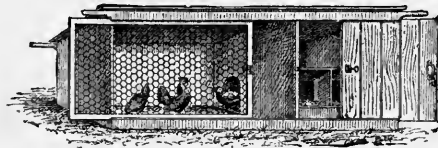


Fig. 185.—Portable Chicken-House.

of room, the hen can be allowed out with them during the day. Chickens are kept in the coops for six or seven weeks, but care must be taken that they are not overcrowded, otherwise they will not thrive nearly so well as would be the case if they have sufficient room. At that age the hen will probably wish to desert them, and they should be removed to a roomy house where they can have plenty of growing space. It must be comfortable without being unduly warm.

With recent years a great change has come over the methods of

feeding chickens, and there is no doubt whatever that the newer systems are a great improvement upon the old. These systems are the direct result of increased production. Where only a few chickens are bred every year the old methods served their purpose excellently. These were that during the first few days the birds are fed upon hard-boiled eggs, chopped fine and mixed with stale bread crumbs, slightly moistened with milk; at the end of, say, a week, for this food is substituted a variety, such as simmered rice, a good biscuit meal, like that made by Spratt's Patent, of London, and oatmeal, the two latter, of course, prepared by steeping, and these are given in alternation; when the chickens are about three weeks old they are given grain, broken wheat, buckwheat, dari, &c., and gradually the other foods, named above, are replaced by cheaper materials, such as ground oats or barley-meal, until the birds come to ten or twelve weeks old, when they are brought on to the foods which are given to the adult stock. For many years this system has proved excellent, but with rearing upon a much larger scale, in many cases it broke down, and both in this country and America other methods have had to be adopted, more especially where artificial raising is carried out extensively. It would take too long to go into the entire history of this question, and to explain all the steps which led to what is known as the "dry feeding system" being adopted, but briefly it may be stated that where birds are reared on a large scale they are fed highly, and there is no incentive to exercise. The food is placed before them at times selected by the poultry-keeper; it is prepared in a manner which is attractive, and thus they feed without having to seek for food. Under such circumstances the tendency is, of course, to make the muscles of the body soft, and also to reduce that power of resistance to changes of temperature which is absolutely necessary. At one time it appeared as if the system of rearing artificially on a large scale would hopelessly break down, and we came to the conclusion that it was entirely a question of want of exercise. Hence some other method had to be adopted, and this is arrived at by abandoning all soft foods and giving from the first dry grain only. This consists of a mixture of various seeds and grains, and in experiments carried out over several years at the College Poultry Farm, Theale, the advantage of the dry feeding system was abundantly justified, for instead of a large percentage of deaths this was reduced almost to nothing. Various dry feeding mixtures are now sold, many of which are excellent, or poultry-keepers can prepare their own. During the first four weeks no soft food whatever is given. The seeds are scattered in cut chaff placed either on the floor of the coop or the brooder, and the birds have to work for every grain they obtain. At the end of four weeks one or two meals of soft food are given daily, consisting of Spratt's meal, oatmeal or boiled rice, and these are continued for a few weeks, as it is found that feeding upon dry grain alone is not sufficient. With increase in age, wheat and other cheaper grains are substituted for the seeds. This system is one which reduces labour to a minimum, but it may be fairly explained that it is not so imperative where hens are brooding the chickens as if they are

reared in an artificial manner. The ordinary farmer who adheres to the hatching and rearing by means of hens does not need to adopt the dry feeding system.

It is not necessary to enter at great length into the question of artificial brooders, but this system is indispensable where operations are upon a larger scale. There are two kinds of brooders, which are called outdoor and indoor respectively. Of the former of these, the Hearson brooder is typical, consisting of a sleeping compartment heated by means of a lamp, and a covered run. Another very excellent type is the Cyphers brooder, differing in construction, and of American make. There are many others which could be named, but that is unnecessary, as these are representative of their different classes. The former is fitted with wheels, and can easily be moved about. Indoor brooders do not require the run, as these are placed under cover, and the birds run out into the brooder house, which is generally fitted with a wooden floor, and upon the floor is placed the cut chaff into which the dry chick feed is thrown. This method is one which has proved itself abundantly successful, and

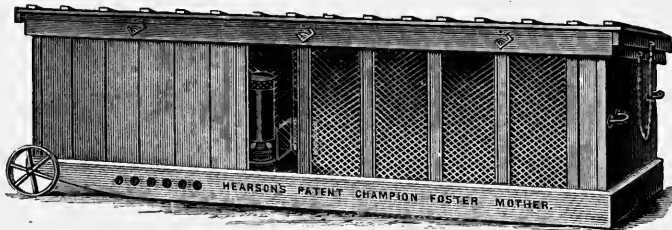


Fig. 186.—Hearson's Brooder.

yields very satisfactory results. For a period of three years, as recorded in the "Journal of the Board of Agriculture," the average number of chickens raised on the College Poultry Farm, Theale, was about 95 per cent., and growth was excellent in every way. In America another system is adopted by which long pipes are fitted to the brooder house, but that has been less satisfactory in that they are not adaptable quite to the same extent as individual brooders. From experiments and observations carefully recorded, it has been proved that, inclusive of cost of egg and hatching, a chicken can be raised to twelve weeks old for 9d., but that does not include labour and interest on capital. If, therefore, we take the actual cost at 1s. each, it will be seen that the margin of profit in chicken raising is a very considerable one, but, of course, much depends upon the success with which the work is carried out, and the above notes will indicate the directions which, up to the present time, have proved themselves to be in every way satisfactory.

## CHAPTER VI.

## FEEDING AND FATTENING.

THE subject of feeding is a most important one, in connection with which the first question to be asked is, What is food, and what does it do? We cannot do better than quote from Professor Atwater, who says—"The body is a machine. Like other machines, it requires material to build up its several parts, to repair them as they are worn out, and to serve as fuel. In some ways it uses this material like a machine, —in others it does not. The steam-engine gets its power from fuel; the body does the same. In the one case wood or coal, in the other food, is consumed. But the body not only uses food, but its own substance also, for its fuel. When the fuel is burned in the furnace, only part of its latent energy is transformed in the mechanical power, which the engine uses for its work; the larger part is changed to heat, which the engine does not utilise. A large part of the potential energy of the food, and of its own substance, which the body consumes, is likewise transformed into heat, but this heat the body uses, and must have to keep it warm. And finally, metal from which an ordinary machine is built and repaired is very different from its fuel, but the same food which serves the body for fuel also builds it up and repairs its waste."

From this we learn that the body is the machine, and food the fuel which provides the motive power. But food is more than this, for it repairs the waste of tissue, and restores that which is lost by the elimination of heat. What this waste is depends greatly upon the conditions under which the animal exists, and the work it has to perform. There is no perfect food for poultry—perfect, that is, in its suitability to all kinds of fowls wherever they may be. What is the right food to be given depends upon the conditions under which birds are kept, and the purpose for which they are destined. Food should vary according to the season of the year. A little Indian corn may do good in winter, but it is bad in warmer weather, and such foods as rice may be useful in summer, but would be useless in winter. So, when we desire eggs, the food should not be flesh- or fat-forming more than is sufficient to repair the daily waste of tissue and heat, but should contain constituents requisite for the making of albumin, fat, and phosphates, which form the principal ingredients in an egg. It will easily be seen that, when the weather is cold, the material available for the making of eggs is considerably reduced by the elimination of heat from the body, and therefore, if they are at all to be produced this loss must be made good. On the other hand, if flesh is to be formed, to give egg-making constituents would be waste of food, and fats are chiefly useful in this direction. And again, chickens require different food to adults, because of the necessity to build up the frame and form the feathers. In this connection it is desirable to add that as far as possible

the food supplied should be well balanced, or there may be great waste, and for the same reason there should not be too much or too little.

The three principal groups of food constituents are—1, Albuminoids or nitrogenous compounds, or flesh-formers; 2, Carbohydrates, or heat-givers; 3, Fat. These are necessary for fowls (except the carbohydrates), and are found largely in flesh and eggs. In deciding upon the food it is necessary first to consider that which is obtained naturally. Where fowls are in absolute confinement everything must be supplied, but when they are given full liberty they obtain a considerable quantity of natural food, by which is meant worms, slugs, seeds, and lime, and the amount of this must largely determine both the quantity and nature of that furnished artificially. No soil which does not contain a supply of worms is suitable for poultry. Well-drained, heavy land is, therefore, the best. The artificial foods are grain, meal, meat, and vegetables, and as no one food is all-sufficient, these must be varied according to circumstances. Oats form the most perfect food for laying hens. Barley should not be given alone, as it is too rich in heat-givers but deficient in albuminoids. Barley-meal mixed with middlings makes an excellent soft food. Wheat, slightly deficient in fat but strong in albuminoids and heat-givers, is good for layers, small wheat being the best. Maize, very deficient in albuminoids, but highly charged with carbohydrates and fat, is a bad food. Buckwheat—deficient in fat, otherwise good; suitable for layers and breeders. Potatoes are useful to take up meal of any kind. The best summer foods are oats, wheat, and buckwheat; and for winter, barley and buckwheat, with a very little maize. The best foods for laying hens are oats, wheat, buckwheat, and a portion of barley; and for fattening, barley and maize, whilst rice, if mixed with tallow scrap, is an excellent food for this purpose. A system which has largely come into vogue of late years is the giving of grain in litter of straw or cut chaff, more especially for birds in confinement, as it ensures exercise in seeking for food—an important point in egg production.

In his "Poultry Breeder and Feeder," Mr. W. Cook says:—

"Perhaps, however, the most important, and very often the most neglected, thing that poultry in confinement require is a supply of grit, for without it they are unable to digest or grind their food. A miller cannot grind his corn without stones, and it is the same with poultry, and if they fail in getting a supply of small sharp stones (which the greater part of the grit should be composed of) they suffer in health, as these things are to poultry what teeth are to human beings—birds digest or grind their food with small stones or grit, while we masticate ours with our teeth.

"When I have had poultry suffer in health and die, I have opened them and often found an absence of these necessities, and very often when fowls mope about and do not care to eat their food, it is simply for want of these small stones, and frequently when in this state, they do not care to pick up the small stones, &c., in which case some should be

mixed with the meal and forced down their throats, when, as a rule, they will soon be all right.

“The round shingle which is sent from the seaside, and used by hundreds as grit, is simply useless, as it, being round, cannot perform the necessary work. Very sharp small stones are required, in fact the edges cannot be too sharp. The friction of the water constantly flowing over the shingle causes it to become in time as smooth as glass. Egg-shells help to form the new shell; but they should be broken very small before being given to the fowls, otherwise it may teach them to eat their eggs. Sand and small gravel, such as may be obtained at the bottom of steep country roads after a storm of rain, or ordinary road scrapings, are also much liked by poultry, and if none of the above can be obtained flint or pebble-stones should be broken up small and given them, as grit they must have in some shape or other.”

After recommending boiled corn during the winter season, the same author goes on to say:—“Fish is a very good thing to give fowls when convenient. Unless it is oily fish, and given very liberally, it does not taste in the eggs. English people do not cultivate herbs as they ought to for the use of their poultry. There are two herbs most valuable in the poultry-yard, and yet they are trodden under foot and thrown to the rubbish-heap, or rooted up altogether as the most wretched things that grow. These herbs are stinging-nettles and dandelions.

“The stinging-nettle is one of the most cooling for the blood that can be found among all herbs. At the same time fowls do not catch cold after having them (as they are liable to do with sulphur). The nettles should be got when young; they can be cut short and boiled, and then mixed with the soft food, and the water they are boiled in will also do to mix with their food. If time will not permit of boiling them, they can be put in a vessel of some kind, and boiling water poured over them. Cover them over, so that the steam cannot evaporate. The nettles and the tea can be mixed with the meal; also add a little salt. When given in this way they are both food and medicine. It is rather difficult to gather them, unless a glove is put on to handle them. They can be cut with a knife or scissors, not pulled; then they grow again very quickly. Nettles are invaluable for fowls.

“Dandelions are an excellent herb for the liver. They will often put the poultry right when everything else fails. The leaves can be pulled from the roots and cut in small pieces, and given just in their raw state. If the roots of these two herbs are set in the autumn or winter (not later than February) they will grow anywhere if they are put underneath the soil. The nettles can be found by the sides of hedges, and dandelions by the roadside, or on any waste piece of ground.

“Watercress is an excellent green food for poultry, but rather too dear to buy. Where there are many poultry kept, and spare ground is at command, cow-cabbages are the most economical to grow, as they grow very large, and if grown properly, one is sufficient for fifty fowls in one day; the fowls are particularly fond of them. A mangel for a change is very good. It is well to cut the mangel in half; then there is nothing left but the skin. Those who live in towns and have but little

space, cannot grow either cabbage or lettuce, but can grow rape, mustard, or maize. These can be grown in boxes with a little earth and manure, and must be well watered. The seed springs very quickly, and in the hot weather is ready in a few days. By having seven boxes, and sowing every day, there is a daily supply of green food. The maize springs twice or three times without sowing again. It can either be cut, or the box placed in the run for the fowls to peck it off. The size of boxes must vary according to the number of fowls kept; not more than two or three inches of soil is necessary in the boxes. If the space is very limited, the boxes can be placed on the top of the fowl-house, but in the sun as much as possible. This green food can only be grown in the summer months."

In France and America the system of caponising is largely adopted, and until this example is more widely followed in England we cannot expect to produce such excellent specimens of table poultry. In its physiological bearing the operation corresponds exactly with that of castration as applied to a colt. The following description is that of Farmer Miles. The instruments can be purchased of surgical appliance makers.

The best birds to operate upon are chickens which have never yet crowed; and about three or four months old is the best age. The birds must be kept without food for thirty-six hours or more before being operated upon. A good light (sunshine if possible) should be available, and the full light should be allowed to shine in the chicken's side when opened. First take two strong thick pieces of string, or thin cord, three feet long, to one end of each attach a weight, or an equivalent in the form of a brick or stone, fastening the other end of the string to the chicken's legs. Then lay the bird on its left side, and drop the weighted end of the string over one side of the operating table. Now tie the free end of the second string round the bird's wings near the body, and drop the weighted end of this string over the other side of the table. The chicken will thus be properly secured, and the operator must stand so that its back will be towards him. The small feathers from the hip bone to the ribs, over the last rib, must now be plucked off, and the ribs and feathers all round should be wetted with a sponge dipped in quite cold water, or ice can be used if preferred, as this wetting will serve to keep the feathers out of the operator's way, and will also numb the fowl, so that he does not appear to feel the operator's knife. Stick the knife in half an inch deep, between the first and second ribs from the hip bone, and cut downwards and forwards to the end of the ribs. Turn the knife and cut nearly up to the backbone. Now put in the spreader, which is one of the instruments used, tempering the tension by the rubber band provided for the purpose, to suit the size of the fowl, and with the spreader open the ribs, after which split the inside striffin that covers the bowels. The upper testicle will not be exposed, and should be grasped by the grippers, which should be given one entire turn over so as to separate the testicle from its attachments, except the spermatic cord. Pull the testicle out, and then treat

the lower testicle in the same way. It is necessary to be careful not to rupture the large vein under the testicles, and also to get the whole of the latter out. The bird may be untied and allowed to go without the incision being sewed up, but for a few days it should not be allowed to fly up to roost. Birds may in this manner be caponised in any number, and without loss of more than one or two per cent. Large breeds of poultry when caponised young, and well fed until ten or eleven months old, and then fattened, will weigh 14 lb. or 15 lb. each, and the meat on them will be found of the tenderest and most succulent description.

It is to be noted that the chief dangers found in practice with all systems of caponising, is in tearing the veins near the testicles, which results in the bird's bleeding to death, and in the losing of the testicles amongst the intestines, an accident which is almost certain to cause inflammation and death. These occurrences seldom happen except through want of care, or inexperience, but it is important to have a good light, in order to prevent such as far as possible. The want of care can be avoided, and, to overcome the want of experience, it is better for a novice to make his first experiments on a dead chicken, so as to learn exactly the position of the place to be cut, as well as of the testicles. A little study of anatomy in this way is highly useful, and, in fact, it would be cruelty for any novice to commence operations on a living bird. The first time must necessarily partake of the nature of an experiment, and, therefore, there should not be any risk of giving unnecessary pain. Amongst the essential conditions for all operations are firmness and confidence,—without which a bungle is sure to be made—and these are not to be had except there is actual knowledge of the subject, and of what has to be done. This actual knowledge can only be obtained by experience.

The fattening of fowls has not received that share of attention in Britain which it deserves. In France the system has been reduced to a science, and the fattened fowls of that country are the finest in the world. But in France all fowls to be fattened are caponised, and without the introduction of this system we can never hope to produce such table poultry as do our neighbours across the English Channel. The process of fattening is a very simple one, and the effect remarkable. A capital article by the Hon. Rose Hubbard, better known under her *nom de plume* of "Henwife," appeared a few years ago in the "Live Stock Journal Almanack," and a portion of this may be quoted :—

"On most farms there is some disused barn, cowshed, or old stable, which can be utilised as a fattening house, and if it be water-tight in the roof, the wooden sides can easily be repaired sufficiently to keep out snow and cold winds. The floor, probably of earth, must be levelled and sanded, well beaten down and rendered hard with an admixture of lime and water; the walls should next be cleaned and whitewashed, and a couple of glass windows introduced. The walls may now be fitted with coops of the most common deal, each about 24 by 13 inches. The floor-boards must be sufficiently thick to support



the weight of the shelf above. The front of each coop is a barred door turning on hinges, while a hinged flap runs the whole length of the coops, deep enough to admit of the introduction of a scraper to each of the pens. A projecting ledge supports the troughs which contain food.

“The process may be described briefly as follows:—Keep rigidly clean; let the place be rather dry, and the birds not see each other; feed twice a-day the first fortnight, and three or four times a-day after that; keep to the exact time of feeding, and remove all food left after the

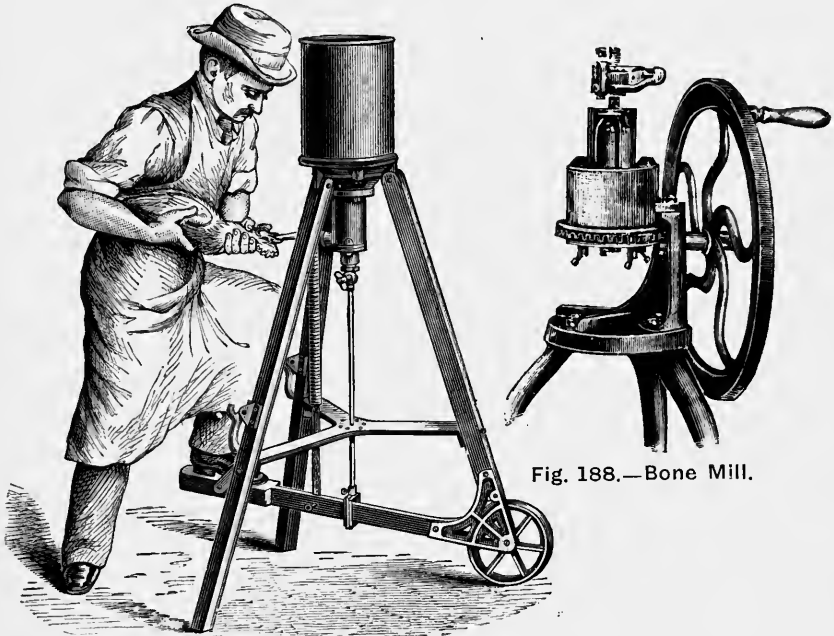


Fig. 187.—Poultry Cramming Machine.

Fig. 188.—Bone Mill.

appetite is satisfied; no sour food or dirty dishes must be used; for food give barley-meal, maize-meal, buckwheat-meal, oatmeal, toppings, boiled barley or rice, and skim-milk; kill the bird (after starving for 12 hours) when it is fit.” Messrs. Charles Hearson & Co. have introduced a capital fattening machine (fig. 187). This is similar to that used so largely in France. Sussex fattening pens are made of rods of wood, open on all sides. Fig. 188 shows a mill for grinding bones, supplied by Spratt’s Patent Co.

How to fatten geese has already been mentioned, and the process as to ducks is pretty much the same. The method adopted in the Aylesbury district is to keep them in flocks of about twenty or thirty in pens well littered with straw, and here they are fed upon boiled rice or barley-meal, mixed with chopped bullock’s liver or tallow greaves, and

they grow very rapidly indeed. It is a common practice to allow Aylesbury ducklings no water and very little exercise. Turkeys are fed on barley and maize meal, mixed with milk, and also sliced mangel, turnips, and swedes. In all cases cleanliness is essential, and the food must be both sweet and good.

Marketing is an important consideration, but scarcely comes within our present scope. To secure the highest prices the best produce must be marketed, and many complaints are simply due to poor quality. At the same time great difficulties are put in the way of producers, but the organisation of the trade has been taken in hand. This is by means of *Dépôts* formed on co-operative lines, as advocated by the National Poultry Organisation Society, and these have led to a great improvement in the quality of British produce.

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## CHAPTER VII.

### DISEASES OF POULTRY.

WHILST there can be no question that of late years the number of affections from which poultry suffer has largely increased, this number is not so great as would at first sight appear, for diseases have been differentiated, and they are better known than was formerly the case. The object of the poultry-keeper should be to keep his fowls as free from disease as possible, and to this end he should treat them in a common-sense manner. A most prolific source of disease arises when new birds are purchased, or when specimens have been away at shows. Very often new conditions serve to develop any latent complaint that may exist, and hence if birds are placed amongst the stock without any precaution there is grave danger lest they introduce disease, perhaps of the most serious nature. For this reason it is desirable to place newly-purchased birds, and also those returning from shows, by themselves for a few days, in order to give time for the development of any trouble, if such there be. In dealing with this question of diseases it will be convenient to classify the latter in accordance with their nature.

#### RESPIRATORY ORGANS.

*Catarrh, or Common Cold.*—This is very common both in the spring and autumn, and the symptoms are similar to those in the human subject. Keep warm, feed on soft food, which may be sprinkled with Aromatic Compound; wash the nostrils, eyes, and mouth, twice a-day with weak vinegar and water; give homœopathic tincture of

aconite, or any of the prepared roup pills, such as Chamberlin and Smith's, or Vale's.

*Bronchitis.*—A further development of the same disease, and one which is often hereditary, so that birds affected with it should not be used for breeding. The symptoms are cough, rapid breathing, rattle in the throat, and general state of fever. Cure is difficult, but the active symptoms may be relieved by keeping in a warm moist atmosphere; feed on soft food, and mix a little nitric acid with the drinking water. A medicine called *Euphorbia pilulifera* is highly recommended for all respiratory complaints.

*Consumption.*—Neglected colds in birds which are naturally delicate, or have been made favourable subjects in any way, sometimes run into consumption. It is needless to say that when this is the case the best way is to obtain fresh and untainted stock, and to begin *de novo*. The symptoms are familiar enough—pale face, short, quick cough, and gradual wasting away of the sufferer. We have known other symptoms result from pressure of the intestines, which was cured by pills made from Brown's Aromatic Compound and butter, but there was not the cough. Cure of consumption is impossible.

*Pneumonia, or Inflammation of the Lungs.*—A most deadly disease, to which highly-kept birds are more subject than are others. It arises from their living in a close, warm atmosphere, and then being suddenly exposed to cold. Hence the necessity for well-ventilated houses, so that there shall be a constant current of fresh air, and that the heat within the house shall not be too much above the normal temperature outside. The symptoms are similar to bronchitis, but in a much aggravated form, and there is that catch in the breathing which is ever indicative of inflammation. Unless relieved the disease soon runs its course, and the sufferer dies. It is useless prescribing remedies for pneumonia, as the best course is to kill the bird affected, and to see that the cause is removed in the case of other birds.

*Roup.*—Though primarily associated with the respiratory organs, for which reason we shall deal with it in this section, roup is one of those terms which mean much more than was at first intended. It implies that there are the symptoms of cold superimposed upon some other affection, such as diphtheria or tuberculosis. There is usually the same discharge from the nostrils as in common cold, but often the eyes swell, and the mucus discharged is of the most offensive character. In the case of ordinary cold there will be no offensive smell, but with this complication the breath is very strong indeed. The commonest form is the tuberculous, which may mean a deposit of scrofulous matter in the throat, the lungs, or the liver. To eradicate it from the system is no easy task, and a bird so affected will be much better killed, though cure is possible in some cases if taken in time. There is another form which is more serious, that known as diphtheritic roup, a contagious disease which has been communicated to man, so that the greatest care is needed in handling birds affected. Its course, when once a poultry-yard is attacked, is most rapid, and, unless heroic measures are taken, the stock will speedily be decimated,

Professor Walley recommends swabbing the throat with a solution of carbolic acid, so as to destroy the skin which forms across the throat. The medicines named already are very useful in combating cases of roup in the earlier stages. The following treatment is recommended in a recently published work on Poultry Diseases, issued by Mr. L. Upcott Gill, "Bazaar" Office:—

"First, for immediate relief, liberal spongings of the head with tolerably hot water half a dozen times a day. Immediately after the bathing hold the fowl's head over a wide stoppered glass bottle so as to inhale the fumes from its contents, which are to be as follows: Carbonate of ammonia, broken into rough powder, two ounces; rectified oil of amber, twenty drops; essential oil of copaiba, fifteen drops; and pure carbolic acid, ten drops. These must be well mixed and pressed firmly into the bottle; a very large smelling-salts bottle answers well. The roupy bird must be given whiffs of this—three or four every half hour. When the ammonia becomes exhausted a few drops of the strong liquid ammonia may be added. At the same time that these measures are being taken the following medicine should be given: Balsam of copaiba, one drachm; sub-carbonate of potash, one scruple; powdered gum ammoniacum, half a drachm; and powdered gum acacia, one drachm. Make into a paste, and give a piece the size of a horse-bean three or four times a-day."

Again would we repeat that care must be taken to prevent the spread of the disease, as it is very contagious.

#### DIGESTIVE ORGANS.

Derangements of the digestive organs are very common amongst domestic poultry, and are largely due to the improper methods of feeding adopted, the giving of too rich foods, and the unnatural conditions under which many birds are kept. If unnoticed,—and in too many cases they are unnoticed until serious mischief has resulted,—or if neglected, they develop into the forms noted below.

*Indigestion.*—This may arise from sudden changes of the weather, as well as from those causes which have already been named, but if taken in time need not cause much trouble. Want of—or a depraved—appetite, indolence, lack of lustre, scanty droppings, and paleness in face are all indications, as is a bad breath. When these symptoms are noticed, a mild aperient should be given, followed by a rhubarb pill on alternate days, and very plain food, somewhat limited in quantity.

*Diarrhœa.*—A slight attack of diarrhœa is often merely due to nature correcting herself, and we should hesitate to stop it at first. If continued it is then necessary to take steps, and in case of adult birds the best drug of which we know is chlorodyne, but it should be given carefully. Rice boiled in milk, and a little chalk mixed with it, is an excellent thing as food. For chickens the rice should only be employed at first, and to it should be added bone-meal, which is an excellent preventive of all such complaints. Sometimes worms are the cause of

diarrhœa, and when they are noticed the treatment recommended for them may be adopted.

*Dysentery.*—Diarrhœa neglected often becomes dysentery, or this may be symptomatic of a more serious state of affairs. The evacuations are very profuse and most offensive. When the disorder assumes this form cure is difficult. The feeding should be the same, and for adult fowls five drops of laudanum mixed with the same quantity of fluid carbolate should be given twice a-day. The patient must be kept warm and dry.

*Enteritis.*—Large numbers of poultry die every year from this complaint, which is an inflammation of the intestines. It is due as a rule to poison, or to some powerful irritant, and generally the course of the disease is very rapid. For treatment see Gastritis.

*Gastritis.*—In this case the inflammation is of the stomach. The symptoms are intense thirst, constipation, quick breathing, and extreme prostration, and the causes are over-stimulation, irritants in the stomach, poisons, or internal injuries. Treatment should be a little salad oil three times a-day, homœopathic tincture of aconite, with lime-water and milk, and light but nutritious food. Such diseases as these are difficult to cure, and even if success be attained the bird will be left so prostrate as to be useless for a long period of time.

*Liver Disease.*—The great development of this complaint during recent years is of very serious import to poultry keepers, and of high-class poultry there are comparatively few unaffected by it. It is due, when not hereditary, to over-rich foods, to bad water, and to foul soil. It takes several different forms, but the external symptoms in nearly all cases are the same, so that it is difficult to determine them until after death. There is a moping on the part of the birds, general lassitude, an uncertain appetite, and a yellowish hue on the face, comb, and wattles. The treatment must be eradivative, and the food of the plainest nature, but at the same time nourishing. For medicine give an aperient twice a-week, and doses of homœopathic tincture of podophyllin twice a-day. It is to be noted that all rich food must be carefully avoided, and that the free use of Indian corn has been most injurious in spreading this disease. When neglected it develops into active inflammation of the liver, for which there is no cure.

*Crop Bound.*—By this name is meant the impaction of the crop, when the passage of food from that organ into the stomach is stopped by the presence therein of some obstruction. Therefore, however much the bird may eat no good is done, for food remains in the crop. If in time, gently working of the crop with the hand, after pouring a little warm salad oil down the throat to soften it, is usually effective. Failing that, it becomes necessary to open the crop and remove the contents. To do this the feathers should be plucked, and an incision made about an inch long, through which the contents must be brought, taking care to remove all, and after washing out with warm water, and oiling the inside, stitch up again the inner and outer skins separately. Feed the bird on soft food in small quantities for a few days, and put it on to ordinary diet very gradually.

*Soft Crop.*—When the crop is distended with air or water it is known as soft crop. Empty the contents by holding the bird upside down, and pressing the crop. Failing this it must be punctured. Feed on small quantities of soft food, and do not allow much water, which should be slightly acidulated.

#### EGG ORGANS.

Troubles of the egg organs are frequent, especially during the spring and summer, and are due to over exertion, or to weakness, but if dealt with promptly are seldom serious, and can be easily cured.

*Soft Eggs.*—This is the commonest form, and some strains are very prone to this bad habit, if weakness can be so called. The eggs are laid without a shell. Under some conditions it is simply due to deficiency of shell-forming materials, which can be easily remedied by supplying lime, old mortar, broken oyster shells, &c. Fright, or chasing of the birds, may also be the cause. But when it is due to weakness, feed on rice to stop laying, and inject a little oil into the vent daily.

*Egg Bound.*—When an egg is retained in the passage the state of things is more serious, for until it is removed the trouble is hourly aggravated. A dose of castor oil, and oiling the vent, will generally be sufficient, if the mischief is discovered at an early stage. Failing that, give the bird some chopped groundsel mixed with warm treacle. In very obstinate cases the parts should be held over a jug of hot water, so as to soften them. Care must be taken not to break the egg, or more serious consequences will follow.

*Inflammation of the Oviduct.*—Scrofulous deposits, the breaking of an egg in the oviduct, or an injury to the organ named may equally induce this trouble, and the cause must be removed ere a cure can be effected. Inject warm water, oil the vent and passages, give some aperient, and if the obstruction, should there be one, is near the orifice, it must be carefully removed.

*Prolapsus.*—Falling of the bowel, or “down behind,” as it is sometimes called, is generally due to weakness from over laying. Give some good tonic, return the bowel, and inject sulphate of zinc, dissolved in water. Laying should be stopped to allow the parts to resume their natural form.

#### LIMBS.

Many diseases of the limbs are due to internal causes, and must be dealt with as such, and others are symptomatic of affections which are treated under other heads. But there are those in which the limbs only are affected.

*Leg Weakness.*—Young chickens are especially liable to this affection, and a too rapid growth of the body, an inherent weakness, or the want of proper bone-forming materials in the food may each or all be the primary cause. To avoid this it is an excellent thing to give bone-meal to chicks, for that material, if of the right kind, contains ingredients in which some soils are deficient, and which are not available

when birds are reared in confinement. Rice, maize, and similar foods are objectionable if used alone, and in fact maize should not be used at all. A good tonic is needed, of which many forms are sold for the purpose, and the circulation may be increased by rubbing the legs well with turpentine. Lime should always be at hand.

*Cramp.*—Early chickens often suffer from this complaint, the toes being drawn together, instead of spread out in the proper manner. Damp and want of exercise are the cause, and also weakness. To remedy this the place where the birds are kept must be dry, and they must be encouraged to work for their food. Give internal tonics, and, after bathing the feet in warm water, rub them well with turpentine; then encase them in flannel moistened with the same fluid, and place near a fire.

*Rheumatism.*—Older birds, more especially of the heavier and five-toed varieties, sometimes suffer from this complaint, those bred or kept upon very damp soils especially so. Of course there is some taint in the blood which must be eradicated. A good aperient twice a-week is helpful, and sulphur should be mixed with the food. The legs should be rubbed well every day with camphorated oil, and three to five grains of nitrate of potash should be administered daily. To reduce the inflammation doses of aconite may be given, and the food should be rather stimulating.

*Bumble Foot.*—The five-toed varieties are subject to this complaint, which is a swelling on the ball of the foot, either in the form of an abscess or of a corn. If the former, it must be punctured; if the latter, cut out. The place should be dressed daily until healed, and the bird kept on soft straw or hay. In other breeds than those named the same result is met with, due either to injury of the foot, or to flying down from too high a perch.

*Scaly Legs.*—Of this there are two forms, one due to failure of the oily secretion, resulting in a dryness of the scales, and the other to the presence of a parasite. There are various ointments sold for this trouble which are very efficacious, or these can be made. For the first named form of disease vaseline and zinc ointment applied daily will effect a cure, and for the latter, or parasitic form, wash the legs daily, scrubbing them with a hard nail-brush, and then apply sulphur ointment. So treated, this disease is easy of cure.

#### SKIN AND COMB.

*Eczema.*—An eruption of the skin, generally found on the face and wattles. It is due to an affection of the blood, the result of keeping under unnatural conditions. The small scabs or crusts are very irritable, and the bird appears thoroughly out of condition. Cooling medicine should be given at first, such as magnesia, followed by pills made of calomel, two grs.; Barbadoes aloes, eight grs.; and gingerine, half gr. This will make three pills large enough for fowls. Dress the skin with a lotion made of one dr. of carbolic acid and six oz. of distilled water.

*Scabies.*—This is really a form of mange in fowls, being due to the presence of a parasite in the skin, and it is very contagious. The places affected should be dressed with some good mange lotion.

*White Comb.*—When the comb, which in a state of health should be bright red, becomes covered with a white scurf, which if not checked will spread down the neck, it is called white comb. It is a form of scurvy, and is due to bad conditions. The diet must be plain and wholesome, the water pure, the ground fresh, and all the conditions healthy. Clear the system by a good dose of aperient medicine, and then follow with tonics, giving a rhubarb pill twice a-week. Should any eruption appear on the comb, dress it with salad oil in which a little Jeyes' Purifying Fluid has been mixed.

#### NERVOUS SYSTEM.

Affections of the nervous system are commoner than would at first be supposed. It may be that the same conditions which tend to the increase of these complaints in man are at work in fowls.

*Apoplexy.*—The commonest form is that of apoplexy. A bird, apparently well, dies suddenly, no cause being evident. On examination it is found that it has had a fit of apoplexy. The cause is nearly always overfeeding, and maize is accountable for much of it. The premonitory symptoms are unsteady gait, drowsiness, and apparent objection to any exertion whatever. The bird is almost without exception very fat. When these symptoms are noticed the patient should have a strong purgative, to be repeated the third day, and the bird should be absolutely starved for twenty-four hours at least. Feed on moderate quantities of plain food, such as barley, and give daily doses of homœopathic tincture of nux vomica.

*Paralysis.*—From similar causes paralysis of the body sometimes ensues, and there is practically no hope of saving any fowl so afflicted.

*Vertigo.*—Sometimes birds are affected with a sort of giddiness or staggering, which has not actually become apoplexy, though it is a premonitory symptom. They can be revived by holding under a running tap, and then treated as for apoplexy.

#### ACCIDENTS, &C.

*Torn Comb and Wattles.*—When cock birds are kept together there is always danger of their fighting, with damage resulting to their combs and wattles. The parts should be well cleansed with cold water, and the ragged portions that are not likely to heal together cut off. Sometimes the torn parts can be stitched together, and if they need it this should be done. As a rule, it is only necessary to bathe the parts twice a-day with cold water, and anoint them with vaseline.

*Fractures.*—Cases have been known when broken legs of fowls have been mended, and surgery of this kind can be attempted by those who have the necessary skill, time, and patience.



## BOOK THE EIGHTH.

### ON FARM OFFICES AND IMPLEMENTS OF HUSBANDRY.

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#### CHAPTER I.

##### THE FARM HOUSE.

THE farm-house should be designed so as to be at once a fitting residence for the tenant, and a convenient office for carrying out the business of the farm. It has become more than ever necessary that economy should be exercised in the construction, and in the size, because the landlord cannot expect so great a return in rent as formerly, and can thus afford to lay out less; and as the profit from working the land is proportionately smaller, the tenant cannot spend so much in furnishing or in keeping up his home as when the returns were greater. At the same time, when a man puts a considerable amount of capital into a farm he is entitled to as good a home as men following other pursuits involving equal capital.

As a matter of business in the letting of farms, it has been found on many estates a good outlay to build houses of perhaps rather more extensive size than the returns from the farm would warrant, for an attractive home gives an air of prosperity to the farm, and it is only natural to be proud of a good home. Some land agents appreciating this, have successfully carried out a system of building a better class of house on poor land farms than on the more productive, on the principle that a good farm will let itself, while the attraction of a good house with pleasant surroundings is necessary to induce men to take the less productive. It has been estimated that one year's rental would be nearly sufficient for the cost of the dwelling-house, but this would hardly meet the requirements of the times, unless little attention were paid to durability, and it is not good policy to build for short duration such a necessary adjunct to the farm as the house. Rents have fallen so much that old figures do not apply, and it must remain a matter of business calculation with the landlord as to what he can afford to lay out, whilst he has to bear in mind that every attraction has to be offered in order to induce a new tenant to take a farm. But extravagance in style is not warranted, and a neat, comfortable, and fairly commodious house is all that should be attempted. The kind of house depends so much on

the system of farming adopted, that this is not the place to enter fully into the details of plan and construction, but merely to mention a few points which should be borne in mind, especially remembering that the farm-house is the centre of the farmer's operations.

Perhaps, before arranging the site of the farm-house, the position of the farm-homestead should be decided upon, for if the most convenient place for this is determined, it will also be the most suitable for the farmer to reside at; but as the position of the homestead will be discussed in due course, this is only by the way. A somewhat elevated position will be found most healthy; it should be well drained, and will be all the better if the soil is porous. A good supply of water is very necessary. The house should overlook the homestead,—not to encourage the occupant to farm “indoors,” but so that in case of his absence others may see that affairs are progressing properly outside. Still, it is desirable that the house should not be too close to the homestead, in case of fire, or lest unpleasant odours should find their way in from the live stock. Every farm-house should have a room to be set apart as an office, in which the farmer may keep his accounts, receive business visitors, store medicines, special seeds, and various necessaries. The room may be small, but it is very essential that there should be some such apartment as this entirely set apart for the master. There can be but little doubt that the lax way in which many men carry on their business is greatly due to the want of a convenient place in which to transact it, for it is almost impossible to attend properly to business in an ordinary living-room, where frequent interruptions are well-nigh unavoidable. The dairy, if it forms part of the house, should be placed in a cool situation, and on no account allowed to be used as a pantry or larder. Milk absorbs taint and odour so freely, that nothing should be permitted in the dairy but milk and pure air: unfortunately it is too often used for other purposes.

There are few points so much neglected in the construction of farm-houses as the *convenience* of the inhabitants. The facility and the pleasure of carrying on many of the operations of husbandry depend on a judicious arrangement of the abode of the farmer.

The house and the offices should be of a size and on a scale adapted to the produce of the farm. In planning the house, both the comfort and pecuniary interest of the master require that the kitchen shall not be a thoroughfare; nor should any house-door open directly into it, with the exception of the mistress's store-room, which should adjoin it and be connected with it. This will save her many a step in the course of every day. The ground floor should contain a good parlour and kitchen, and attached to the latter a back kitchen, which may serve the occasional purpose of a bakehouse and brewhouse. A pantry, and some place that can be used as a cellar, must not be forgotten. It is essential for the ground to be raised a foot or eighteen inches above the outside level, as this will contribute much both to cleanliness and to health. The best way to secure this is to raise the timbers of the ground floor above the ground level by having the house approached by two steps; or, preferably, by three.

On farms consisting of from two to three hundred acres, these apartments on the ground floor, with four bed-rooms above, and a sleeping-room, with a separate staircase, for men-servants,—where it is still the custom to board and lodge some of the hands,—either in the garret or over the offices, will be found sufficient. On those of a larger size, a house of superior dimensions and accommodation will of course be deemed requisite.

The drainage should be perfect, for illness is as likely to originate from bad drains in the country as in towns. Care should also be taken that trees and shrubs are not planted too close to the house, as their roots frequently block the drains; laurels in particular are troublesome in this way.

THE FARM-YARD AND ITS OFFICES, OR THE ARRANGEMENT AND CONSTRUCTION OF THE FARM STEADING, "FARMERY," OR "HOMESTALL."

Farm-homesteads are too commonly built with little regard to the nature of the farming pursued: they are practically the workshop of the farm, and if they are not conveniently placed and selected, the nature of the work accomplished is bound to be more or less inferior. On a grazing farm, fewer offices are requisite than in other branches of farming; but it is nevertheless highly necessary to have distinct buildings for the various kinds of cattle, and that the whole of these should be so distributed as to facilitate the labour and convenience of the servants; that no distances be needlessly traversed, no time lost in going from one apartment which is wrongly placed with reference to another.

This general principle as to the relative arrangement of the different sections of the farm offices or "farmery," or by whatever one of the names—indicated in the heading to this section—they may be called, is of the most vital importance. A farm steading viewed as a whole may seem, if on the large scale, to be a complicated arrangement of a number of buildings more or less isolated from each other, and of apartments more or less numerous; thrown together apparently without any fixed rule or guiding principle of arrangement. That this is but too literal a description of many farm steadings designed, and in some cases actually erected, is, we regret to say, exemplified in various districts of the country. The inspection of a well-designed homestead arranged by one who is conversant with the work to be done in it, and with the practical requirements which it is designed to meet, will reveal a leading principle, or principles, the nature of which we propose briefly here to state.

To one of these we have already in a general way referred, and that is the importance of arranging the relative positions of the various apartments, which go to make up the homestead, in such a way that the work of the farm shall be carried on in the most convenient manner. Numerous and diverse, in relation to the purposes which they are

erected to serve, as are the apartments which make up a steading, the latter may be grouped in three classes. (1) Those connected with the produce of the farm, and with its preparation for market and for the feeding of stock. (2) Those connected with the housing of the live stock of the farm. (3) The various structures which may be called miscellaneous, and which are used for a variety of purposes in promoting the work of the two other groups, as, for example, store houses for food and for implements, workshops, manure pits, and sheds of different kinds.

It is obvious that more than one way may be suggested of combining or arranging these various groups. They may be arranged in that rough and ready fashion which sets at defiance all attempts to classify them, much less to prosecute in proper sequence the work done in them; or they may, on the contrary, be so arranged that the work of the one group will aid that of the other. This latter it need hardly be said is the true principle. When this is adopted, the various groups of apartments above-named fall at once into their proper places; those connected with stock occupying one part, those with produce another.

But this principle of arrangement must be carried yet farther. For it is not enough that the stock apartments, for example, shall occupy a certain position in the general plan; it is necessary that, as there are varieties of stock, so also there must be a secondary grouping, so to call it, of the apartments they use, so that each separate variety shall occupy the place best suited to it. Thus, for example, the apartments, &c., for those varieties of stock which require the largest supplies of straw should be placed in the closest contiguity to the barn in which the straw is stored; whilst, on the other hand, ready access should be secured to the manure pit or dung-slucie or shed, as well as to the turnip or root store. Take again the case of dairy cows; they do not necessarily require straw for bedding, but where it is allowed to them room is needed for it, and also for the different kinds of food, either those grown on the farm, or supplied from external sources. The stores for these will require, therefore, to be near the cow-house or byre; and this again as before near the manure pit, whilst it should also have a certain definite relationship to the apartments in which the milk is made either into butter or cheese, or into both. Yet they must not be placed so near as to run the risk of contamination. The piggeries should be placed so that the waste from the dairy and cheese-house may be readily conveyed to them, but as this is chiefly in a liquid form it may be run into a tank near them. When drains are laid from the dairy to the pig-sties, they must on no account be connected with the inside of the dairy, or it will be impossible to keep the milk sweet and wholesome. Then, like the produce department, the straw barn should be near the threshing barn, this again near to the machinery by which the threshing machine is worked, whether this be a steam-engine, or the more antiquated, but useful and economical waterwheel. Next to the threshing barn is the corn barn, in which are placed the machines and appliances used to dress the grain for market, whilst near the engine or other motive power is the general machine room, in which materials or

produce, home or bought, are prepared as food for stock. It will thus be seen that there exists what may be called a cycle or circle of operations to be done, beginning with the stacking of the grain and ending with the manure pit or shed, for the due carrying out of which there are various apartments and courts, and all of these should be placed in that relationship to one another which will best and most economically secure the carrying out of the work to be done.

But there is still another point or principle, and one which is very frequently forgotten or overlooked by some designers of farms, or with which—not being practically conversant with the necessities and requirements of modern farming—they are not acquainted. It is that the homestead should only have those apartments which are absolutely necessary for the carrying out of the operations of the farm for which they are intended. This is such an obvious common-sense principle that it is strange it should ever be overlooked. It is of no use—nay it is worse than useless—to supply, for example, accommodation for dairy work, in a steading where dairy cows are not kept, or, if they are kept, only to the extent of two or three, or perhaps even one, and that merely to supply the needs of the farmer's family.

It is palpable, however, from the nature of our work, that we cannot even glance at, far less fully describe in detail, all the peculiarities of the various classes of steadings suited to the requirements of the different modes of farming. We must content ourselves—and indeed the aim and object we have in view will thus be fully met—with selecting what may be called, two “representative plans,” by the detailed examination of which we shall obtain subjects to illustrate and describe, and these will involve a discussion of all the various apartments and structures necessary for our readers to be acquainted with. These plans are: (1) a mixed husbandry farm; (2) a dairy farm. The *Mixed Husbandry* mode of farming is admirably adapted to afford a representative plan, because, as its name indicates, it embraces nearly every kind of farm practice in the kingdom. Taking this, then, as a representative plan, the following is a brief description of the apartments required for it, and of the relationship which these bear one to another.

To the north of the building is placed the stack-yard. Parallel to and along the southern side of this is a long range of buildings, of course running east and west, as shown by  $ab$  in the diagram (fig. 189). In the centre, and most safely and conveniently outside the wall of this, are placed (1) the “fuel house,” and (2) the boiler house; at this point there is a long range of buildings,  $cd$ , at right angles to the range  $ab$  named above as running east and west, this second range  $cd$  running from north to south. The first apartment in this is (3) the engine-room. Next to this is (4) the corn barn, and then (5) the straw barn. At the end of this is (6) a root store, having a door leading to (7) the boiling or cooking house, next to which is (8) the food store for oil-cake, grain, and artificial foods; and this north and south range, is finished off with (9) a second root store. Here, then, we have two ranges formed like the letter  $\Gamma$ , the leg of which  $cd$  is north and south, the arms  $c b$ ,  $c a$ , east

and west. Returning to the east and west range, and taking the parts of it to the left of the leg of the T, as *c a* in the diagram, we have first (10) the work-horse stable, next (11) the hay house, next (12) the farmer's nag stable, next (13) the food and store room, in which may be placed, if worked by hand, the oat-crushing machines, &c., next (14) the boiling house for preparing mash, and this end of the range is furnished with (15) a poultry house. Taking now the other half *c b* of the range *a b*, we have (16) the machine room (next the engine-house) for preparing the food for dairy cows, &c.; (17) the mash or boiling house, next (18) the hay-house, then (19) the dairy cow-house, and (20) the dairy rooms, comprising wash-house, milk-room with churning and cheese-room, finishing off the range. This back or north range is two-storied, the second story above the point *c* being (21)

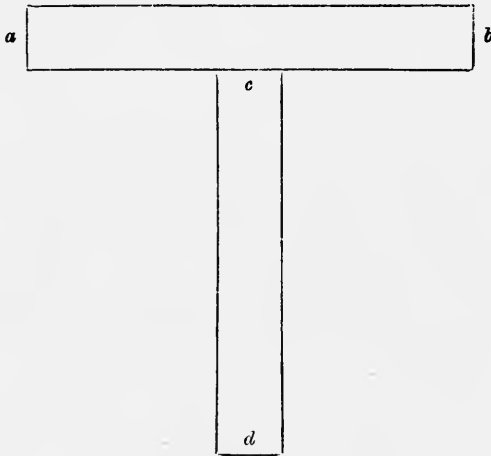


Fig. 189.—Diagram showing disposition of Farm Buildings.

the apartment to which the grain is carried up—by a gangway—from the stack-yard behind, and supplied to the threshing machine, and where, also, the grinding mills, &c., are placed. The remainder of the second story towards *a* from *c* is taken up by (22) the granary, and the extreme end may be furnished by apartments (23) partitioned off from the granary, and appropriated, one end, say at *a*, to (24) a cheese store-room, approached by a stair from the cheese-making and churning-room below, and at the other end of the range to (25) a store room. The north and south range *c d* is also two-storied; but the straw barn is not provided with a second floor, being open from floor to roof, though the extreme end *d* may be floored, and a wool store-room or a poultry house (26) may be made there.

The south range (fig. 190) at *e d f* is taken up wholly by a series (27) of cattle-feeding boxes on both sides. The west side is occupied by a range of buildings which run parallel to the centre range *c d* in the first

diagram, the first apartment (nearest to the point *a*) of which is taken up or occupied as (28) a calf-house, next to which is (29) a turnip store, next (30) an infirmary for sick animals, (31) bull boxes and cattle-feeding boxes, and (32) the piggery. The east side at end *b* of north range

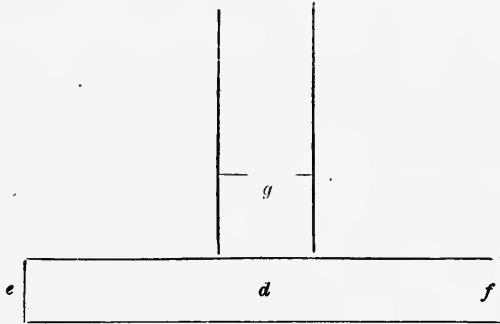


Fig. 190.—Diagram showing disposition of Farm Buildings.

(see fig. 189), has another series of buildings, parallel to those on the west side; the first apartment of which is occupied by (33) the gig or coach-house of the farm, next (34) the cart shed, next (35) the workshop for wood-work, (36) the implement stores, (37) the smith's shop, and (38) the artificial manure stores.

We have now ranges which make a complete quadrangular building,

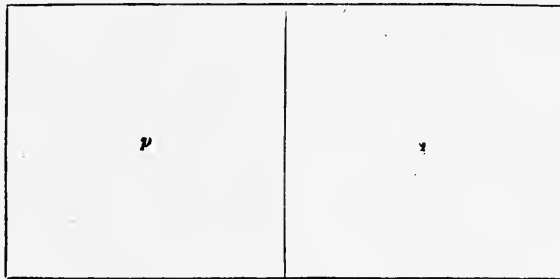


Fig. 191.—Diagram showing disposition of Farm Buildings.

divided into two by a central range, as at *c d* in fig. 189; and thus giving two large open spaces, *p* and *q*, on each side of this, as in fig. 191. The spaces *p* and *q* are filled on the inside, *p* with (39) hammels for the feeding and shelter of young stock, and, in certain circumstances, with sheep shelter-sheds; the space *q* by (40) open cattle-yards and shelter-sheds.

The arrangement here described is not presented to the reader as a "model" one, as we do not believe in "model farms" or "model

cottages," circumstances of locality, soil, climate, &c., bringing into play various modifications; but it is one which, upon the whole, will be found to facilitate the economical and regular working of a farmstead. Thus straw, being a very bulky material, will require much labour to carry it from point to point; but being placed centrally it can be distributed to the stock houses which are placed right and left of it, and as near to it as possible; it is also near to the long range of cattle-boxes on the south side of the range, and to the hammel and the cattle-courts in the central space in *q* (fig. 191). Then again, the stable on the one side, and the cow-house on the other, are in close proximity to the hay-house, milk-house, and food stores; whilst the dairy-rooms are near the cow-house; the implement-stores and cart-shed near the workshops; the turnip-stores are placed at points convenient to the places in which are housed the stock which use them; and finally, by having the manure-pits and tanks at the ends near the outside of the east and west ranges, the dung, &c., from the stable and cow- and calf-houses can be led to them at once. A more convenient place for these, if space could be obtained, would be points near to the hammels and the cattle-courts in the spaces *p q* in fig. 191; they would there serve the stables and cow- and calf-houses as well as the southern range of cattle-boxes.

Of the apartments of the homestead which may either form an integral part of the main building, or be completely isolated from them, those of the dairy are the most important. As to these we now offer a few remarks, premising that they will also be applicable to the special or representative plan of a dairy-farm which we shall presently give. The dairy apartments of a homestead, whether the latter be on the mixed husbandry system now under consideration, or on the special dairy-farm system subsequently described, require to be constructed and fitted up with the most scrupulous care; for of all the substances or materials which have to be dealt with on the farm, there is none which is so liable to "go wrong" as milk, whilst no produce of the farm demands so much cleanliness and purity as the butter and the cheese made from it. Much useful information is contained in Mr. Richard Henderson's paper on "Dairy Buildings," in the Transactions of the Highland and Agricultural Society (5th series, vol. xi., 1899, p. 39).

The dairy apartments proper are, first, those connected with the storing of the milk for the production of cream for churning purposes; second, the room for churning and cheese-making; third, the room for the ripening and the storing of the cheese; and fourth, the washing-house in which the water is boiled and used for cleansing the various vessels and utensils. Let us glance briefly at the essentials to be considered in the construction and fittings of the *milk-room*. As regards aspect, the only admissible one for the windows is due north, or at least north-east: dairy milk-rooms, therefore, in which windows are placed all round, are wrongly constructed. The next point as regards the windows is, that they be all double-framed, with a space left between the frames. The outer frame should be guarded or shielded outside with a framework filled in with fine wire gauze, in order to keep out the flies and insects, and also to let in the fresh air; this framework should of



course be movable along with the outer window-frame, which should be hung door fashion, so that the two halves shall open right and left; and the fresh air be admitted accordingly. The inner window should be double-hung, the upper leaf hinged at its lower edge, so that it can be placed and set at any angle, by pulling chain and weights or by quadrant and thumb-screw—to throw the air up towards the ceiling; while the lower leaf should be made in two and like the outside, window-door fashion, throwing the air right and left. The walls should be built double or with a cavity or hollow in the centre; and the roof should also be double, the ceiling being coved, or higher in the centre than at the sides. These structural arrangements all have in view the object of keeping the air in the interior of the milk-room as uniform in temperature as possible throughout the year, a matter of paramount importance. To remove the used air, or to keep a current in action, ventilating shafts should be provided in the ceiling, with valves easily worked by cords and pulleys so as to regulate the velocity of the currents. In winter, the best means of keeping up the temperature is to have hot-water pipes.

The next object to be secured in the milk-house is perfect freedom from damp, than which nothing is more prejudicial. The site or soil of the house should therefore be as dry as possible, and in order to put the matter beyond risk, the site for some distance round the milk-house should be well and deeply drained. The floor should be dug out for a depth of at least two feet, and filled in with dry cinders, or smithy clinkers, and above this a layer of cement, in which, if a tile-floor be used, the tiles forming it should be carefully embedded. The best tiles are the Staffordshire. The great point as regards the floor is, to have its surface impervious to damp, and all its joints waterproof and quite flush with the general surface, so that there are no hollows in which water, or other liquid, can lodge. Some prefer cellar milk-rooms as giving a more uniform temperature, but there are two objections to these: first, the time lost in descending and ascending the steps, in taking down and bringing up the milk; and secondly, the difficulty of keeping the rooms dry. The first objection can be dispensed with by having an inclined gangway down which the milk-cans can be shot, and a "lift" by which they can be raised to the churning-room; the second, by careful construction—but, upon the whole, we believe the best plan is to have the milk-room on the same level as the other apartments. The shelves in both rooms will be best and most easily kept clean if of perforated cast iron, so that the air may obtain free access to the milk vessels.

The churning-room and cheese-press-room may be provided with a marble slab upon which to work the butter in cases where a portable butter-worker is not employed. An excellent and highly useful addition to the dairy apartments is a small ice-room for storing the butter in hot weather, and for affording ice for occasional use in the milk-room to reduce its temperature, and in the churning-room when making and working up the butter. The ice-room should be next the churning-room, and separated from the washing-room; or a separate washing-

room may be built so that there is no communication, which is preferable in hot weather. The latter apartment must be provided with a copper or boiler to yield a supply of hot-water: and it will be advisable to fix up hot-water pipes to maintain the temperature of the milk in cold weather. The washing or scalding tubs may be either portable or fixed; if the latter, hot and cold water pipes should be connected with them. Every means should be taken to have the wash-room well ventilated, so as to carry off at once all vapours and bad smells, and to prevent their obtaining access to the other apartments. The vessels when cleaned should be placed outside, and to protect them a verandah should be erected. If this be carried round the house, it will tend to keep the interior temperature uniform.

The other and remaining apartments of the homestead, which may, like those of the dairy, be either isolated from, or form part of, the main building, are two in number, the poultry-house and pigeon-house.

Of the poultry-house we have already, in the book on poultry, given general details. To these we may add the following:—All poultry-houses, to be healthy and profitable, should not only be free from damp, but sheltered in winter-time, and at the same time supplied with fresh air in abundance. Some advocate a soft floor, so that the poultry can peck at it and form dust-baths or holes in its surface, but all the pecking should be done out of doors, and the dust-baths formed in the small yard attached to the house. We consider cleanliness the first point to be aimed at in the house, as the only way of keeping down the vermin; this can best be secured by having a floor capable of being washed and quickly dried. Damp in a poultry-room is a prolific cause of disease, and should be carefully guarded against in floor, walls, and fittings. Warmth, in moderation, is also essential to poultry, and if the house can be placed near the engine-room or other apartment where there is a source of heat, so much the better for the house and the poultry. Some poultry experts have even gone so far as to recommend the special warming of poultry-houses; but, although this is necessary for young chickens hatched in incubators, it is not so for hens, which are protected by nature against cold weather at least as well as any other farm animal. As to the fittings, or the roosting-poles, much again has been written,—perhaps the simplest are the best, namely, rough battens or branches of young trees split up the middle, and placed like a sloping gallery, so that all the droppings shall fall to the floor directly from the roosting-poles. Some prefer the surface of the floor to be covered with sand or ashes—if covered at all, the former is perhaps the better material. In some cases the poultry-house is placed on the second floor or granary floor; in which case a part of the granary near the end is partitioned off. There is no doubt that a house so situated will be dry and warm, compared with one on the ground floor. Proper ventilation should not be neglected.

As to the "pigeon-house," this is usually a separate structure, well known from its peculiar and anything but graceful architectural style,

if that term can be applied to a building in which no style at all is observable. Yet there is nothing to prevent this from being a really ornamental feature in the farm buildings. If, however, expense should stand in the way, then the pigeon-house may be made very comfortably at the side of the poultry-house, if that be, as indicated above, placed on the granary floor. Pigeons generally get their living on the farms, and are a source of annoyance on account of the way they have of pulling, or burrowing into, stacks after corn. Moreover, they block the water spouts so much with their dung that many farmers prefer not to keep them, but as the birds look graceful about the place, homesteads are often not considered complete without a dove-cot. Hence these annoyances are put up with, although there are considerable doubts as to the profitableness of the birds.

We now come to consider the case of a *Dairy Farm*, the second "representative plan" we have decided to illustrate.

The large increase in the population of our towns, especially in the manufacturing and mining districts, and what may be called the larger proportional increase in the wages which the people now receive, have added largely to the number of consumers of farm produce. For milk, butter, and cheese the demand is great. Dairies on a large scale are now therefore becoming very common, and what is termed the manufacturing process is carried out in connection with them. It will be well, therefore, to glance briefly at some of the leading points connected with these arrangements and constructions. Where milk is sent away straight from the cow-shed, there is, of course, no need for any other convenience than the refrigerator, which can be placed conveniently near to the milking-house, though the proximity to a cool well of water must be considered.

The dairy buildings proper are those in which the milk is stored, prepared, and fitted for the after or final processes, such as butter and cheese making; and, being quite distinct from the buildings in which the milk is produced, they may either be connected with or detached from these. But as the two departments are so intimately connected, and as the processes of the one cannot be carried on without the products of the other, it will be well to glance, however briefly, at what constitutes the apartments of a first-class dairy homestead.

The main or principal part is of course the cow-house, or byre, in which the cows are kept. This is fitted up with stalls, either single or double, and the rows of stalls are so arranged as to give the largest amount of working space beneath the minimum extent of roof surface, the great object being to furnish the roof as cheaply as possible. If the dairy farmer breeds his own stock and does not buy them in, accommodation will have to be provided for the breeding and rearing department. This will comprise a bull-house, and premises for the young cows which are to supply the dams. This accommodation may be given either in the form of stalls, boxes, or hammels, but stalls are the best, as they can be used when the heifers are in calf and being fed, and also when they calve, for which latter purpose boxes or hammels would not be suitable. A "calf house" will also be required,

fitted up with pens as elsewhere described; and, in the sequence of rearing operations connected with stock, yearling-houses or hammels for young stock. Should the dairy farmer not breed and rear his own stock the accommodation named above will not be required, excepting the cow-house or byre. But we should strongly recommend such accommodation to be given on all dairy homesteads; because although one tenant might not breed and rear his own stock another might do so. And indeed we would as strongly recommend the dairyman not to buy his stock in the open market or from chance dealers, but to breed and rear his own; for this plan will yield him the highest satisfaction and the largest profits.

The next accommodation required in a dairy homestead is "the piggery." This is essential on the majority of farms, as the pigs will consume the skim-milk, butter-milk, whey, and general offal from the farm, which there is sometimes a difficulty in otherwise getting rid of, although where the dairy farm is near a manufacturing town there is often an opportunity for selling the first two. It is, however, a point often discussed, as to whether the highest profits are not to be obtained by giving the skim- and butter-milk to pigs or calves; we are inclined to think that they are, and that therefore the dairy farmer should always keep pigs. At all events a "piggery" should be set up; and in connection with or close to it a food store, and boiling-house for the preparation of mashes, &c., for the use of the pigs and brood swine. There should be a dung-pit not far away from, but not quite in connection with, the piggery.

Such is the accommodation—with the addition of an extra house for the purposes of an "infirmary," and if one for calving be given as another extra, it will at times be found very useful—on what may be called the dairy part of a farmstead. We have now to point out that which will be necessary for the arable culture connected with the dairy farm. Little, however, need be said upon this point, inasmuch as it is, both in extent and character, very much the same as that already described in connection with mixed husbandry, with the exception that accommodation for fattening stock forms no part of it. There are the engine-house—to begin with the source of power—and boiler-house, placed close to and in connection with the threshing-barn, next to which is the straw-barn. The machine-room will be near the engine-room, so that power may be taken off at once to cut the roots, grind the corn into meal, &c., and to do the varied work of the food department for the horses and colts, and also for the cows. Next or near this will be the food-stores, one of which will be devoted to roots, the other to more valuable food. The hay-house will be next to the cart-horse stable, near to which will be the cart and implement shed and store, the carpenter's shop, and general store; and, outside of all, the central or principal covered manure pit, with its attached liquid-manure tank.

These will make up the two great departments of the dairy farm accommodation, but it will be observed that no space has been given to the apartments required for the making of butter and cheese, or the

“dairy apartments” proper. This has not been done because, according to the plan decided upon, these may either form part of the general plan of the homestead, or be placed in an isolated range of buildings. Each method has its advocates, and there is, as usual in such cases, a great deal to be said on both sides of the question. The great argument in favour of having the dairy-rooms isolated from the general buildings is that the milk is removed from the cow-house or byre, and thus the risk of its becoming tainted is greatly lessened. The importance of this we have already fully discussed in its appropriate place. On the other hand, by having the dairy-room isolated from the general buildings, considerable loss of time is incurred, whilst there are other inconveniences which will be obvious on consideration. Taking, however, all the points involved, we should be inclined to say that the balance of opinion as to the scientific treatment of the milk, &c., is in favour of having the dairy-rooms quite isolated from the general farm apartments in which work is continually going on, and giving rise to taints and smells, dust, &c., which cannot but be prejudicial more or less to the dairy products. A very slight consideration of the subject will show that there is something in the general farm apartments, as the cow-house or byre, quite antagonistic to the work of the dairy proper. The points connected with the apartments which are generally known as the “dairy,” we have already discussed in connection with “Mixed Husbandry Homestead.”

Having now examined the two representative plans embracing all or nearly all the various apartments required in steadings to suit the necessities of different styles of farming, we have next to consider the general points connected with all homesteads, such as the site, position, and allied details.

And first as to the *position* on the farm. Much discussion has arisen on the point as to what part of the farm the buildings should be placed upon. The central point seems to be the most convenient, as all the carting to the fields of manure, and from them of produce, will be equalised between the various parts of the farm. But this rule may have to be modified according to circumstances, such as the proximity to the main road, and to the railway station, and the places at which the best supply of water can be obtained. This latter is, indeed, the point which will most often decide the position of the buildings on the farm, for water both of good quality and in abundance is essential; but should water only be obtainable in unfavourable situations, it may be necessary to build the homestead in a convenient place, and force the water to it by means of a hydraulic ram, or other mechanical method. The first thing to be done, therefore, is to ascertain where water is most conveniently obtainable. As there is carting to, as well as from, the buildings, a comparatively level situation is better than one on a hillside, but occasionally advantage is taken of a sharp hillside to save trouble in filling barns, &c., for a roadway may be constructed on the higher side of the buildings in such a manner that the carts stand on a level with the upper windows, so that there is no lifting required by the man emptying. Few farmsteads surpass one held by Mr. George Street, of

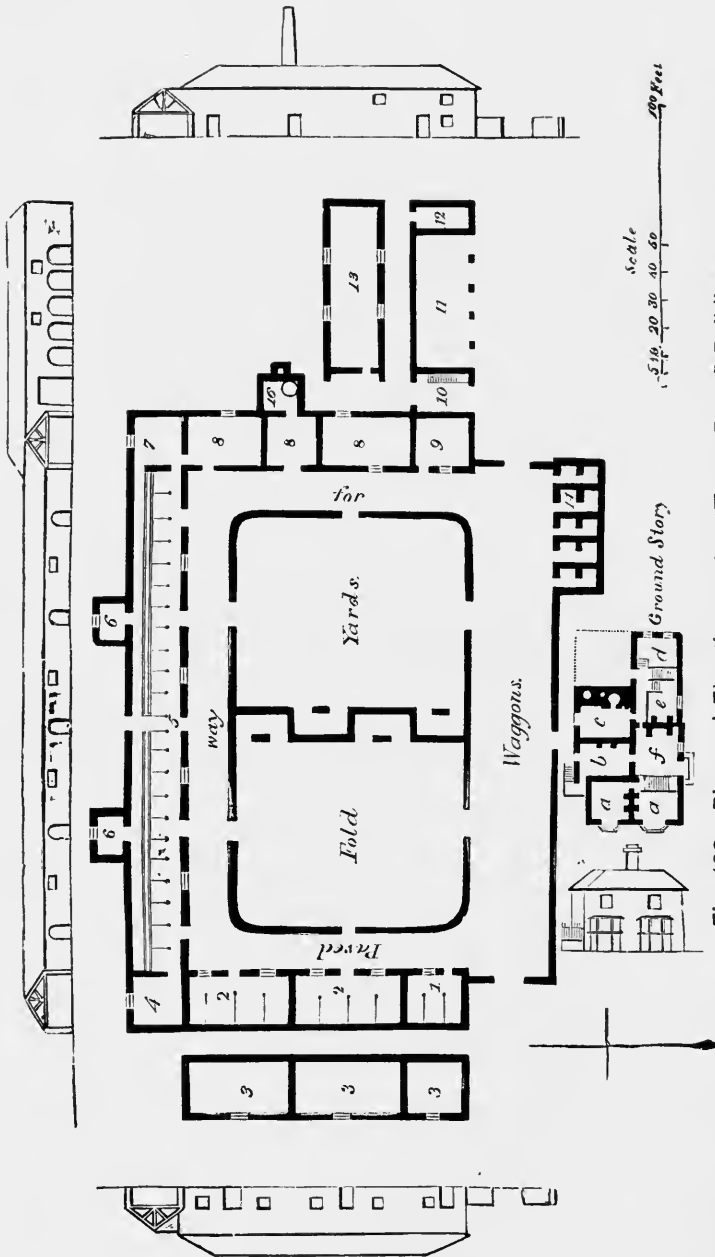


Fig. 192.—Plan and Elevation of the "Tearn Farm" Buildings.

Maulden, on the Duke of Bedford's estate, for conveniences which have been obtained by adapting the buildings to the natural surround-

ings. Care should, of course, be taken to secure a site which will give a good fall or declivity to the various drains. Sites near marshy lands, and indeed near rivers, should be avoided, as dampness is bad at any time for the stock. The *aspect* of the building is also of great import-

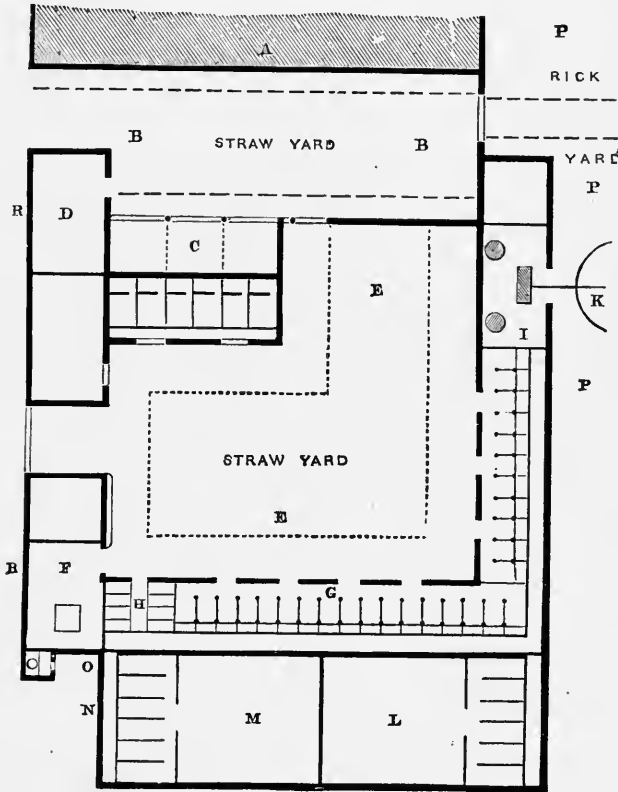


Fig. 193.—Ground Plan of Mr. Timms's Steading.

A is the threshing barn, with straw and hay barn and granary adjoining. B, a straw yard. C, open stalls for stock. D, cart house and nag stables. E, straw yard, with paved causeway round it. F, the food cooking house, with steam boiler and steaming apparatus. G, a range of buildings divided into stalls for bullocks, with a gangway at the head for feeding the animals. H, calf pen. I, a building containing the chaff machine, bean mill, oat crusher, &c., worked from the horse gear at K. L, hammels and small yard for sick and other stock. M, hammels for two bulls. N, liquid-manure tank and pump. O, labourers' closet. P, stack yard. R, road.

ance, as influencing the health of the animals occupying it. The south-east is the best, as this gives a greater amount of sun-light during most days in the year. The beneficial influence of light upon animals has only within the last few years been recognised and acted upon—not, however, so extensively as could be wished.

A few plans of farm-steadings may, at this stage, be usefully intro-

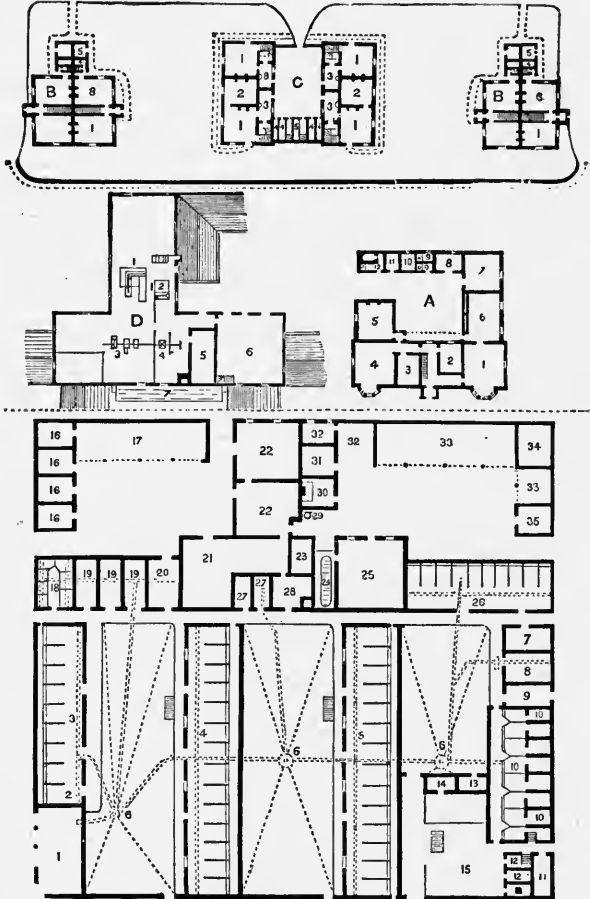


Fig. 194.—Steading at Liscard, Cheshire.

Reference to Numbers on Fig. 194.

1, compost house. 2, bull house. 3, shippon for 16 cows. 4, shippon for 28 cows. 5, shippon for 32 cows. 6, manure tanks. 7, gear house. 8, milk-horse stable. 9, pigs' food. 10, piggeries. 11, ducks. 12, turkeys, geese, &c. 13, shed for pigs. 14, shed for poultry. 15, poultry yard. 16, potato stores. 17, implement and root shed. 18, calf house. 19, loose boxes. 20, grains. 21, straw house. 22, barn. 23, engine house. 24, boiler house. 25, granary. 26, stable for 10 horses. 27, cut chaff. 28, steaming house for roots. 29, well. 30, smithy. 31, carpenters' shop. 32, churn house. 33, cart shed. 34, drill house. 35, slaughter house.

Reference A.

1, parlour. 2, stores. 3, office. 4, living room. 5, scullery. 6, dairy. 7, curing house. 8, smoking house. 9, privies. 10, ashes. 11, tubs, &c. 12, oven and boiler.

Reference B.

1, living room. 2, pantry and stairs. 3, kitchen. 4, ashes. 5, coals.

Reference C.

1, kitchen. 2, parlour. 3, scullery. 4, coals. 5, ashes.

Upper Floor of Barn D.

1, threshing machine. 2, separator. 3, hay cutters. 4, linseed crusher. 5, drying kiln. 6, granary. 7, tank.



duced. The first (fig. 192) is that erected on the farm of Tearn, of which the extent is 1,160 acres. The soil is almost wholly that adapted for barley and turnips, to which is added a small proportion of irrigated or water-meadow land.

In fig. 193 we give the ground plan of Mr. Timms's farm-steading, erected on his farm at Framley, Surrey, near the Farnborough Station. The farm is remarkable for its poor soil, being in fact part of the extensive sandy and dreary tract of land known as Bagshot Heath. Yet, by high farming, by the liberal use of manure, by the exercise of the greatest care in cultivation, and by keeping a large stock of animals—to the 250 acres, 60 oxen, 350 sheep, 70 hogs, and 20 horses which yield large supplies of dung,—Mr. Timms succeeded in raising his poor sandy farm to the highest degree of fertility; so that it yielded double and in some cases treble the amount of crops obtained upon other farms in the same neighbourhood.

A dairy-farm steading which has long been regarded as a "model one" is that of Liscard, Cheshire, the property of Mr. H. Littledale. Of this we give, in fig. 194, an illustration.

*Covered Farm Steading.*—In fig. 195 is shown the ground plan of a partly covered homestead, built from the designs of Messrs. Baily Denton, Son, & North, on a Northamptonshire farm of 270 acres, of which 150 acres are arable, and 120 acres pasture. The "Agricultural Gazette" thus describes this homestead:—

"It provides stall, box, and yard accommodation for 50 beasts, standing for 9 horses and 4 cows, a calf pen, three pigsties, and two loose boxes, with a shelter shed and yard, available either for horses or for young stock, all in easy and direct communication with the cutting and mixing-floors. And there is abundant room for housing implements and for storing and dressing corn. The special feature in the homestead is the covered yard, which is provided with ample ventilation and light. It consists of a wide centre span, with lean-to roofs therefrom, the space between the top of the roof to the eaves of the centre span being filled in with thick glass louvres, as are also the fanlights over the large front sliding doors. The stalls, boxes, and yard are well supplied with water from a cistern in the mixing-floor, which is fed by gravitation from a spring on higher ground. The walls are built of stone lined with brick, and the buildings, with the exception of the covered yard, are roofed with local slates. By making the utmost use of materials from old buildings previously on the same spot, the cost of this homestead barely exceeded 2,000*l.*"

Fig. 196 is the ground plan of a covered homestead near Metford, on a farm of 1,240 acres, of which about 1,000 acres are arable, and 240 acres pasture. The buildings were erected for a portion of the farm lying at a distance from the main homestead. They are of brick with tile roofs, and were designed and built by Messrs. Baily Denton, Son, & North, the contract amount being 1,720*l.* As the land is light it is well adapted for sheep, of which a large breeding flock is kept. Beasts are fattened in the yards, stalls, and boxes during the winter, by which

means the large quantity of straw produced on the farm is converted into manure.

Much practical information upon the subject of covered cattle yards is contained in a paper communicated by Mr. W. J. Moscrop to the

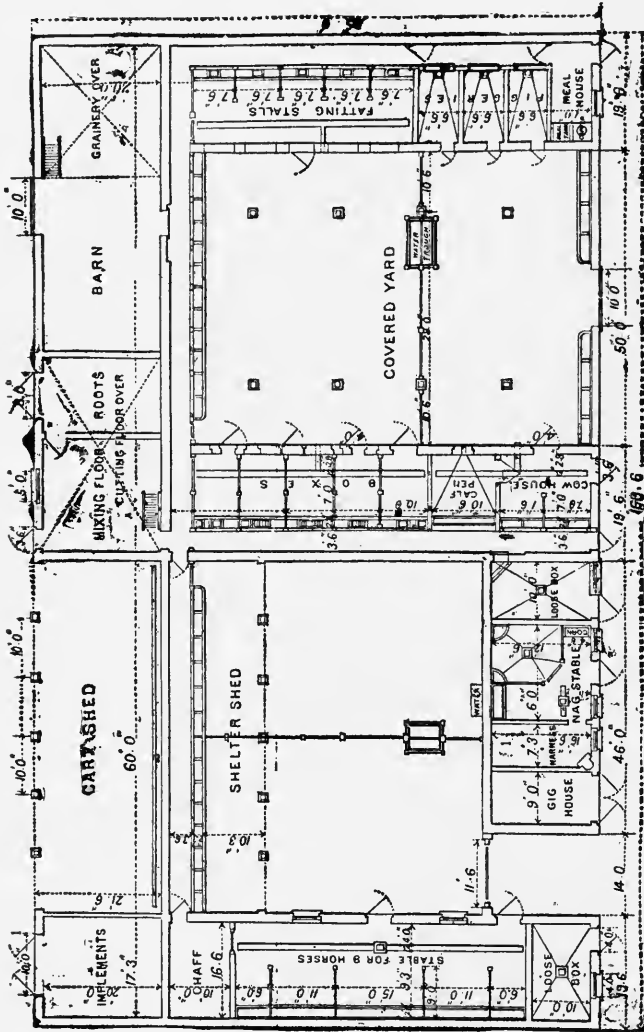


Fig. 195.—Ground Plan of a Partly Covered Homestead.

“Journal of the Royal Agricultural Society of England,” Vol. I., 3rd series, 1890. In the construction of covered yards, the first essential to be kept in view is to secure efficient ventilation. Experience has proved that this can be best attained by openings at eaves height of the building to let the air in, while a break high up in the roof induces a through current and draws off the heated foul air from below. This



Assuming a yard of 60 feet by 45 feet, divided into two, and enclosed by buildings on the north and east sides, Mr. Moscrop by means of a section drawing shows that the eaves openings on the west slope outwards and upwards, and tend to throw upwards the current of air entering the yard. These openings are returned round the east side: but buildings being supposed to exist here, the open spaces are got between the eaves of the two roofs, piers being built on the walls to give the necessary height to the inner one.

The air-current on these sides, it will be observed, is turned downwards; but practically little inconvenience arises from this, the adjoining roofing affording protection from anything except very strong gales and drifting snowstorms. A cheap and simple contrivance, used to obviate this occasional drawback is made of pieces of half-inch board, about the width of the opening, suspended from the eaves between the piers by pieces of light chain. They are dropped when a storm occurs, and afford very effectual protection, and are readily looped up again out of the way when the storm abates. Seldom more than one side of the yard needs protection in this way at one time.

The diagram (fig. 197) shows an ordinary queen-post truss, strong

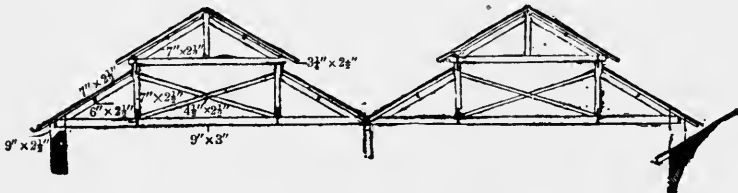


Fig. 197.—Section of Roof Showing Sir H. M. Thompson's Mode of Ventilation, the Covering being Slates or Tiles.

enough to carry a covering of slates or tiles. To get a ventilating opening high up in the roof, the queen posts are lengthened as shown, the clear space of a foot or fifteen inches thus obtained inducing a free current of air across the yard, and through its entire length, without any draught being felt below. The currents from the gables are obtained by leaving openings in them at the same level as the break in the roof and eaves openings. The spars on the upper part of the roof overhang the lower, and thus exclude rain and snow.

The foregoing embodies the principle of "roof ventilation" referred to, which the late inventor said that, "until he was better informed, he would take leave to call perfect." After many years of experience in the construction of covered yards, Mr. Moscrop has no hesitation in endorsing this assertion, and in no instance where it has been adhered to has he seen anything but the most complete success.

Fig. 198 shows section of a roof-truss designed for slates to be laid in a way known as open slating. This mode of covering has been rather extensively adopted, and, with the eaves openings as shown, the ventilation obtained is fairly satisfactory. It will be seen from the sketches A and B (fig. 198), that there is a free space for the passage of

air between every slate. This space,  $2\frac{1}{2}$  inches wide by the thickness of the slate, is, in the aggregate, something very considerable. These spaces being distributed evenly over the whole roof there are no

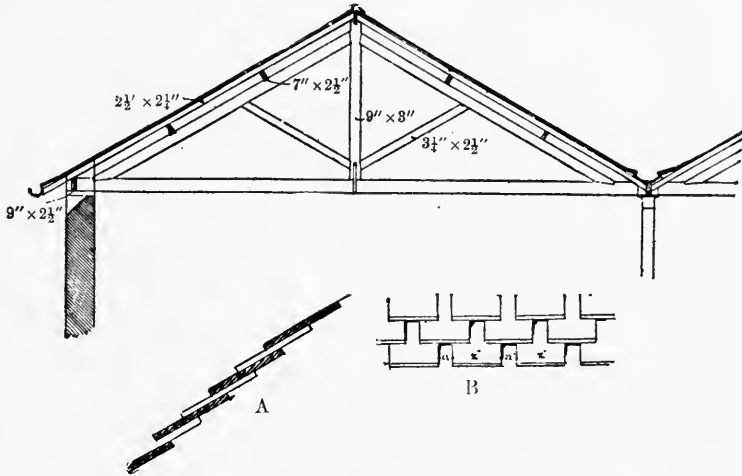


Fig. 198.—Section showing a Roof Covered with Open Slating.  
 A. Section of open slating.      B. Elevation of open slating.

draughts, so that this is another cheap way of getting roof ventilation. The weight being much less than in ordinary slating, the roof-trusses may be placed farther apart, thus resulting in a less costly form of

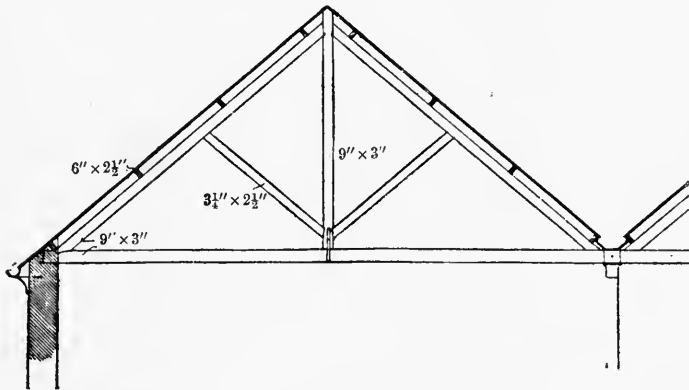


Fig. 199.—Section Showing a Roof Covered with Boards.

structure. Those who have yards covered in this way speak very favourably of them, and, as the cost is moderate, it is probable that, as the plan becomes better known, it will be more widely adopted.

In fig. 199 is illustrated a form of board roof that has obtained con-

siderable popularity. It consists of a covering of boards from  $\frac{1}{2}$  to 1 inch thick, laid on purlins of 7 inches by  $2\frac{1}{2}$  inches, spaced from  $4\frac{1}{2}$  feet to  $5\frac{1}{2}$  feet apart. These rest on principal rafters placed from 14 to 16 feet apart, their scantling depending on the width of span for which they are required. For a span of 30 feet, 9 inches by 3 inches is amply strong enough. For cover, well-seasoned white-wood boards—owing to greater freedom from knots—are considered best, and are more frequently used than red-wood, although it is probable that the latter for this, or any similar outside purpose, would be more durable. They are used in widths of 7 and 9 inches—the former preferable as being less liable to warp. Before the boards are laid, studs are driven into the purlins at the points where the boards would have come into contact with them, and the boards resting on these studs are then securely nailed to the purlins. The object of the studs is to allow a free downward course to any wet that may permeate the roof, and prevent its lodgment on the purlins, besides securing a free circulation of air between the purlins and boards, and tending to the preservation of both from decay.

The boards are laid  $\frac{1}{4}$  inch apart, giving light to the yard, and also affording the means of ventilation. Grooves about  $\frac{1}{2}$  inch wide, and  $\frac{1}{2}$  inch from the edge, are made in them, with the object of catching the rain when blown athwart the face of the roof, before it reaches the openings, and conducting it down to the eaves spout.

A special feature of this roof is that, though the interstices give sufficient light to the yard, and air enough for good ventilation, yet the wet that finds a way through them is in quantity extremely small—quite too insignificant to interfere with the comfort of the animals or to impair the quality of the manure. Indeed, it has been proved that less rain penetrates than when close boarding is used—a curious fact, and not easily accounted for, but a fact nevertheless.

The higher the pitch of the roof the sooner the rain flows off it, and this tends to its preservation; but it is not well to go beyond a given pitch, as, when too high, the rain is found to enter in greater quantity. Lord Wenlock's agent at Escrick, Mr. Walker, who has erected a great many of these roofs, and particularly noted this point, finds a rise at an angle of 40 degrees to be the happy medium between a high and a low pitch. He also advocates a moderate rather than a wide span, finding the water does not get so well away on long-sided roofs than where they are shorter, and is more liable in strong winds to be blown through the openings into the yards.

The first to adopt this board-roof was Mr. Cundy, land-agent of Wetherby, he having got the idea of its leading principle from a brick-maker, who found that his bricks were kept drier when his shelter boards did not absolutely touch than when in contact. This induced him to cover, by way of experiment, a small yard embodying the principle, and the result proved so satisfactory that he has gone on covering ever since.

That a wooden roof is a better equaliser of temperature than any of the others mentioned will be readily admitted. That the Cundy roof

also attains to the first essential of covered yards—efficient ventilation—all who have had experience of it concur in affirming, whilst its first cost is less per yard than that of any of the others. But whether it will in the long run prove the most economical mode of cover is not so certain.

As Mr. Moscrop enters, in considerable detail, into the subject of cost, the reader who requires enlightenment upon this point would do well to consult the original paper. The following conclusions are established:—

1. That, both from an economical and utilitarian point of view, corrugated iron roofs for cattle yards are inferior to, and the least desirable of, all the modes that have come under notice.

2. That a roof embodying in construction the principle of ventilation recommended by Sir H. M. Thompson, whether covered with slate or tile, and the board roof originated by Mr. Cundy, about equally balance in point of economy; but the first cost of the latter being only half that of the former, an owner adopting it is enabled at equal outlay to double the area of his roofing. Hence, in point of utility, it is greatly superior, and deserves consideration from those who have yards to cover.

3. That a spaced open slated roof is the most economical of any, with ventilation not so perfect as the two last named, but yet found in practice to be fairly sufficient.

The advantages of covered yards comprise (1) economy of food in conjunction with the health and well-doing of stock; (2) superiority of manure, and economy in its application; (3) saving of litter.

The money value of the advantages enumerated under the first head is estimated at from 6*d.* to 1*s.* per beast per week during thirty weeks of winter. Under the second head, the advantage may be thus stated:—If manure made in open yards is worth 3*s.* 6*d.* per ton, that made in covered yards is worth 5*s.* 3*d.* Taking the quantity of manure made by a medium-sized beast in a covered yard during the winter months at eight tons, this, at the increased value of 1*s.* 9*d.*, gives a gain of 14*s.* per head for the period named.

On the assumption stated, it would follow that, to obtain equal results, 1½ ton of open-yard manure must be applied for every ton of that made under cover, costing in labour half as much more, provided the conditions of application are alike. But they are not alike, for, as practical men well know, the latter may be drawn from the yard, and applied direct to the land for any description of crop. Not so the former: the large proportion of straw in its composition renders it unsuitable for direct application, more especially for turnip crops, and a cartage to heap, turning, refilling, recarting, and re-emptying are indispensable, thus adding largely to the cost.

The third advantage, saving of litter, is sufficiently apparent. Not more than half the quantity of straw is required for litter in a covered yard that is necessary in an open one, and a reduction of 1½ ton per head of ordinary-sized cattle may fairly be calculated on. This saving may be turned to account as food (worth 30*s.* at consuming value), thus enabling a larger number of cattle to be kept.

DETAILED DESCRIPTION OF THE DIFFERENT SECTIONS OF A  
FARM-STEADING.

*Feeding Yards.*—Having discussed the principles of arrangement of the farmstead as a whole, we proceed to notice the various parts of which it is made up. As regards the preparation of the bottom of the feeding-yards, the following observations will be useful.

A frequent mistake is that of making the yards in hollows, whereby drainage from them is prevented, whilst surface-water can run into them. The practice arose from the desire to make the yards snug, and sheltered from winds, but the winds are less likely than wet lair to do injury to the stock. Where chalk can be obtained, the surface or bottom of the yard should be bedded or coated with it, or with some other material impenetrable to water, in order that the filtration of urine or moisture may be effectually prevented, and the manure carefully preserved; unburned clay, though impervious to wet, should on no account be used, as it treads up, gets mixed with the manure, and is soon carted out, having made a poor bottom at its best. If nothing else is convenient, burned clay is not bad if it is well rammed down.

The construction of the yard should be nearly concave, or shelving towards the centre, to which spot may flow the drainage from the stables and cattle-sheds; and there should be a pipe or drain communicating with the cesspool, or, at all events, with the dung-stance or pit. If a large court is divided into two or more yards, and the whole is shaped in one concave, care must be taken that the gateways are not made in low places, or the bottom will cut up and become almost impassable at wet seasons. We know even of cases where yards have been made with concave bottoms without a drain or cesspool, the consequence being that the middle of such a yard is little better than a pond. To avoid expense, many farmers bottom their yards with earth, or rubbish, in order, by absorption of the drainage, to form a compost in the yard itself. The saving thus obtained is, by experienced persons, regarded as trifling, when compared with the injury probably done to the store cattle by thus retaining the moisture beneath them, dryness of situation being considered most essential to their health, and indispensable to their thriving. The driest bottoming is furze, but stubble, potato-haulm, or any other loose refuse, will answer the purpose; over this the yard should be bedded deep in straw. Earth, though very valuable in a compost, should never be used within the yard.

The farm- or straw-yard should always be sheltered on the north and east by open sheds or hovels, in order that in winter or cold weather the cattle may be protected. The feeding-yards and sheds should be provided with turnip and water troughs. As it is more the custom now than formerly to give the animals short food in the form of chaff, ample manger-room should be provided, and the best position for this is at the back of the hovels. Fig. 200 illustrates a good form of yard-rack for hay and straw. It is made by Messrs. Musgrave of Belfast.



*Cattle-Stalls.*—The structure of these buildings is very simple. Each stall should not only be provided with a crib for the food, but it should contain also a vessel, or trough, for the reception of water, which may be conducted into it by means of cast-iron tubes leading from the cistern or pump. The *size* of the house, or number of the stalls or boxes, must depend upon the manner in which the farm is occupied; but it should never be forgotten that the cattle must have *ample accommodation*.

In order to erect feeding-houses to advantage, great attention should be bestowed on their situation. They should not be too much exposed to the sun nor yet to cold winds. The floors should be gently sloping,

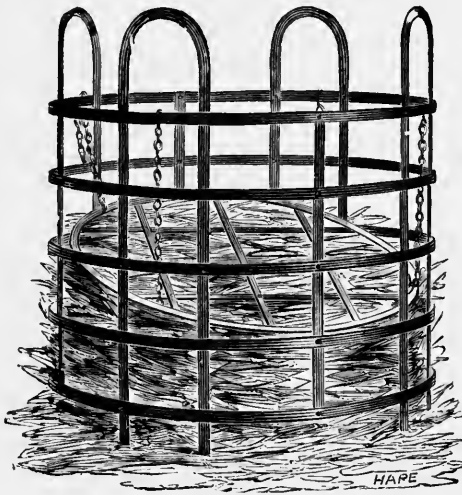


Fig. 200.—Straw-Rack for Cattle-Courts.

with proper drains for carrying off the urine, and for the easy removal of dung and other muck. The floors may be variously paved.

Some have recommended that the pavement should be of pitched stone; others advise the use of concrete; but the least expensive method is to lay the floor with Dutch bricks, or *clinkers*, usually employed for flooring or paving stables. The pavement should not have too great a slope; for, if too much of the weight be thrown on the hind legs, the animals will become uneasy and suffer pain, and be subject to cramp and rheumatism, and consequently will rarely feed well.

The doors should open outward, as by that means a waste of space will be prevented, and the sheds rendered more secure against intruders.

The *width* of the stall varies. For two fair-sized oxen, from *nine* to *ten* feet are considered sufficient. Cows, though in general smaller than oxen, require equal, if not greater space, in order to allow of conveniently milking them, as well as of their suckling the calves;

indeed, it is always best to place them in single stalls. Stalls should not, however, be made too wide, otherwise the cattle will turn round in them, and the stronger beasts will have an opportunity of injuring their weaker companions.

Where the system of stall-feeding is practised on a large scale, it will be necessary that *regular temperature* and good ventilation should be maintained; and especially that apertures be left for the escape of the gases emanating from the breath and evacuations of the animals. There is not a more fruitful source of disease than these gases when confined. If a loft be built over the stalls for the reception of provender, several funnels should be passed through it from the ceiling of the feeding-house to the roof, in order to allow of the escape of the foul air; and great care should be taken to render these funnels, and also the ceiling, air-tight, or the provender will become impregnated with the gases, and rendered unwholesome. It is desirable, however, that the cattle-houses, as well as the stables for the cart-horses, should not have any loft over them. In addition to the windows, latticed or

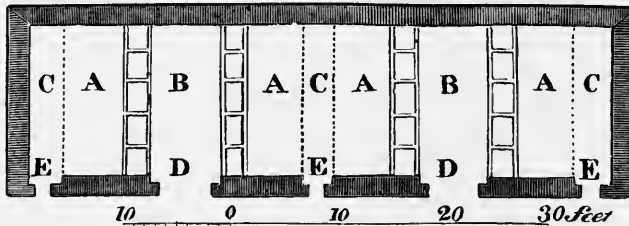


Fig. 201.—Cattle or Beast-House on the Roxburgh Plan.

not, that are on the side of the house, there should be three or four open gratings near the floor, through which the wind cannot blow directly upon any of the cattle, but by means of which a constant circulation of air may be maintained throughout the shed. Slides should be contrived to close them, in order that, when the wind blows violently, they may be shut; but this should be always under the direction of the master. The regular windows should be opened or closed as the season of the year or the state of the weather may indicate. Where it is practicable, these openings should be towards the east or north, in order that the cattle may derive some benefit from the genial rays of the morning sun, or from the cooler air of the day in summer. In addition to this, the large front doors may sometimes be set open for the purpose of further ventilation.

The above plan, fig. 201, of a beast-house, much used in the county of Roxburgh, may not be considered out of place here.

The feeding-house here delineated is 60 feet in length, by 18 in width, and is capable of containing twenty cattle standing in a direction across the house, with their hind quarters towards each other; while a sufficient interval is left for storing up turnips or other winter food. A A A A represent four spaces for the cattle, five being allotted to each

space, which may be fitted up either with cribs or with stone troughs. *B B* indicate two spaces for receiving roots, each interval being 8 feet wide. They are separated from the troughs, or cribs, by means of strong wooden partitions, for which a thin party-wall is sometimes substituted, from 3 to 3½ feet in height. *D D*, the doors, are sufficiently wide to admit a cart, to be backed in, and turned up. Over this low partition the turnips, or other roots, are thrown to the beasts. *c c c* are passages 4 feet in breadth, behind the animals, for the purpose of removing the dung by means of the doors that are respectively marked *E E E*. Should the peculiarities of the situation require, or render it

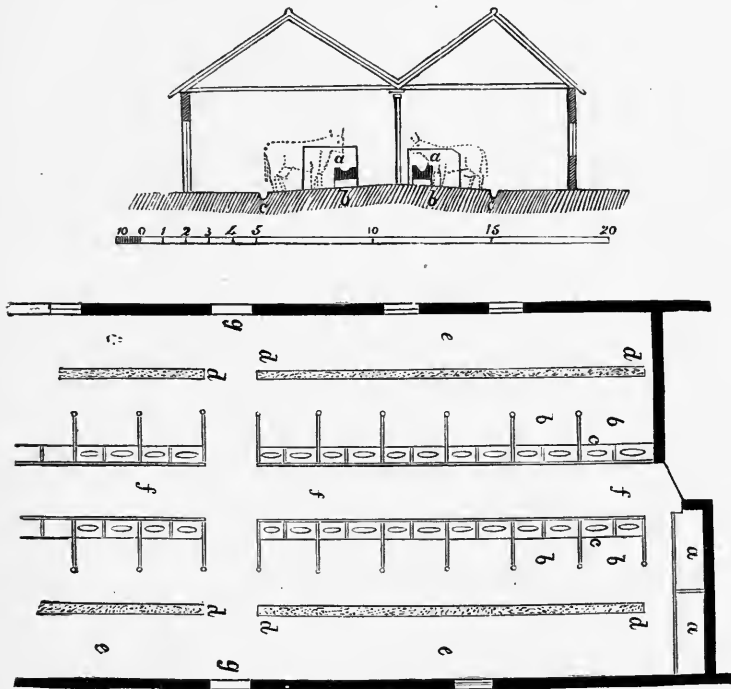


Fig. 202.—Plan and Section of Cow-House.

*a a*, root and straw bins. *b b*, double stalls. *c c*, mangers. *d d*, gutters. *e e*, dunging-passages. *f f*, feeding-passages. *g g*, windows.

In the section *a a* are the travises or stall divisions ; *b b*, the mangers ; *c c*, the gutters.

convenient, the large doors just noticed may be situated in the back of the feeding-byre, or ox-house.

The advantages of the above plan are, a more commodious division of the cattle than when they are ranged in lines along the house, instead of across it ; it also admits of the feeding of store and fattening stock at the same time, for, if five feeding-cattle are placed on one side, and a similar number of young beasts or milch kine are arranged on the opposite one, the green tops of turnips or the spare leaves of

cabbages may be thrown on one side to the young animals, while the roots are given to the fattening or to the working cattle.

In fig. 202 we give the plan and section of the cow-house or byre adopted by Mr. Harvey at his celebrated farm near Glasgow, and illustrated in a "Report of the General Board of Health," from which we take the drawing.

Various modes are employed to secure cattle in their stalls, of which the simplest are the following:—To the partitions of the stalls are fixed vertical rods or bars of iron, on each of which runs an iron ring for attaching to the chain that passes round the neck of the animal. The illustration (fig. 203) show two modes of fixing the rod to the bars of the stall. When the common method of tying-up is insufficient for the security of vicious beasts, another means must be found. A fixed iron chain, by way of a halter, is fastened to a *standard*, mortised into the front side of the manger and the joist above. It is composed of two

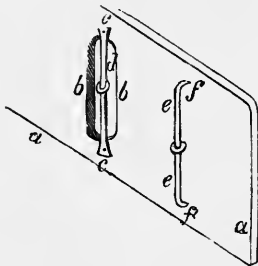


Fig. 203.

*a a*, the travis or stall division. *bb*, an aperture cut in the same, in the centre of which an iron-bar, *cc*, is secured; up and down this bar the cattle-chain-ring, *d*, slides.

In the other plan the bar *cc* has bent ends, *ff*, so that it projects from the surface of the travis *a a*, the cattle chain-ring sliding up and down the bar *ee*.

parts: one of which has sixteen links, and is two feet in length, measuring from the staple; the other, which contains twenty-six links, measures about thirty-nine inches, and serves as a collar. At one end of this *collar-chain* there is a ring, about an inch in diameter, and, at the opposite extremity, a key three or four inches in length, and having a hole at its centre, by which it is joined to, and freely plays in, the last link. The first chain, which by one end is fixed to the manger, is by the other connected with a middle link of the collar-chain, and thus forms two arms, which, being thrown round the neck of the beast, and the key being thrust through the ring, and placed on a bar across it, makes a very secure fastening.

Chains are objected to by many feeders, because, in case of fire, it is impossible to free the animals, which hang back in their fright; while, when stout hempen ties are used, a man can pass along rapidly and free the cattle with a single stroke of a knife. In box-feeding, the animals are not fastened up at all, but remain loose, so that by tramping about they may thoroughly mix and compress the manure.

*Cattle Boxes.* As box-feeding is now pretty generally admitted to be one of the best modes of deriving profit from cattle, we must not, in our enumeration of farm-buildings, omit the requisite compartments for carrying it on successfully. The boxes should be about nine or ten feet square, and six feet in height, and divided one from another by a brick wall to the height of two feet, and above by strong rails about eighteen inches apart; at the back should be a movable trough

or receptacle for the food; the flooring, or bottom, should be of solid clay or concrete, and should be from 18 to 24 inches below the level of the outer ground, in order, with the surrounding brickwork already mentioned, to form a bed for the accumulation of manure;

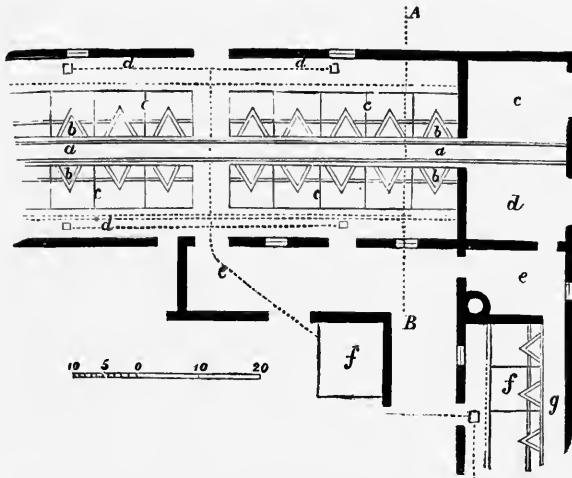


Fig. 204.—Cattle Boxes and Cooking-House.

the roof may be slated or thatched, and the whole completed by a strong door.

A *Cooking-House* may form a desirable appendage to stall- and box-feeding, and should be situated as conveniently near the stalls or

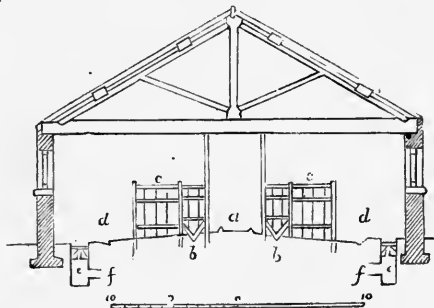


Fig. 205.—Section of Cattle Boxes in Fig. 204.

boxes as possible. It should contain boilers of a size proportionate to the requirements of the stock. The illustration in fig. 204 shows the arrangement of cattle-box-range, and cooking-house adapted to the plan. Fig. 205 is a section of the boxes on the line A B in fig. 204.

The plan and section here given are taken from the "Essay on Farm Buildings," by Mr. Thomas Sturgess, surveyor, Bedale, in the  
 x x 2

eleventh volume of the journal of the Royal Agricultural Society. In fig. 204, *a a* is the tramway along which run the trucks conveying the food to the cattle in the boxes, *b b, c c*; *d d*, line of drain running into drain *e*, which conveys the urine to the liquid manure tank, *f*; the turnip-house is shown at *c*; hay-house at *d*; boiling-house at *e*, and other cattle-boxes at *f* and *g*. In fig. 205, the section, *a* is the central passage and tramway between the boxes, *c c*; *b b*, the feeding-troughs; *d d*, draining or side passages; *e e*, trapped cesspools, from which the liquid is conveyed to the tank by drains, *f f*.

Besides the regular feeding-houses, it will be advantageous to have, for the use of store cattle, *open sheds*, into which they can withdraw from the straw-yard and obtain shelter in bad weather. In each

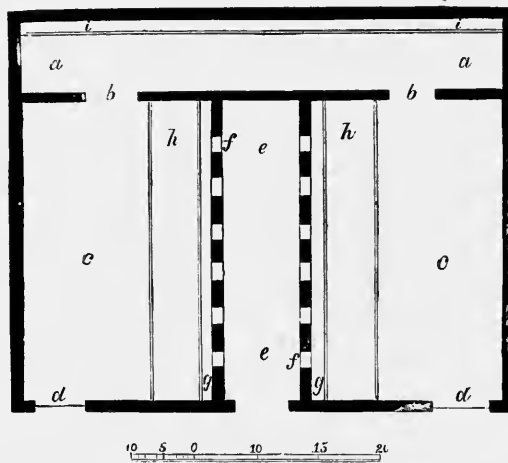


Fig. 206.—Cattle Courts, or Curtains, with Turnip Store.

of these yards there should be troughs for the food, and where that is of a succulent nature there will be no occasion for water. A good supply of water will, however, be requisite when dry meat is employed. The animals should be well littered; and, when necessary, they may be respectively separated in the same manner as in the cow-houses, a similar interval being allowed for each, and the floor being also laid on a gentle descent, not only for the convenient removal of the urine and excrement, the accumulation of which would be highly prejudicial to the health of the cattle, but also for their comfort, by keeping them dry. Such sheds are easily constructed by allowing the roofs of barns, or other lofty buildings, to project forward to such an extent as to afford sufficient shelter, the extremities being supported by strong wooden posts, or pillars, and the height at the open side being not more than seven or eight feet. It is not uncommon to divide yards with a double-shed or hovel, down the middle of which runs a 4-ft. feeding-passage, with mangers on each side. The great objection to them is that unless they are boarded on one side from the manger to the roof there

is always a violent draught. When boarding is put up in this manner, there must be openings with closing slides to allow the stockman to feed the animals easily. The span of the roof should be 32 ft., which will involve queen-trussing.

Fig. 206 illustrates an arrangement of open cattle-yards and feeding-sheds, or “curtains” as they are sometimes called, used in the North of England. The shed *a a* is entered by the doors *b b*, from the cattle-yards *c c*, of which *d d* are the dunging gates. *e e* is the turnip-store or house, from which the troughs *g g*, in the side sheds *h h*, are supplied by flinging the turnips through the port-holes *f f*.

Feeding in what are called “hammels” is a favourite mode with many first-rate farmers. The “hammel” system consists of a series of small sheltered sheds, *a a* fig. 207, entered by the door *c*, from the yard *b*. *d* is the dunging-gate, *e* the turnip trough, and *f* the water trough.

The observations we have already made on the situation and ventilation of cattle-houses are equally applicable to *cart-horse stables*. The walls should, however, be always supplied with casements, not

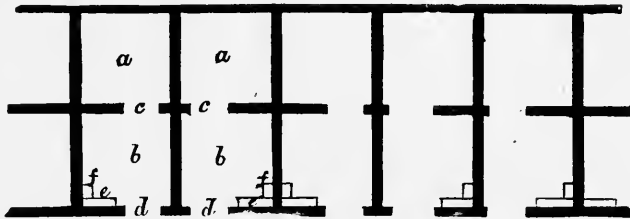


Fig. 207.—“Hammels.”

only for the admission of air, but of more light than is requisite for the cattle-houses; and shutters should, at the same time, be added for the purpose of excluding the light, if necessary, during the daytime. If horses are constantly kept in a dark stable their eyes are weakened, and, if nothing more should happen, it is liable to make them shy at ordinary objects which they cannot discern clearly. The door should be as near as convenient to the entrance of the farm-yard, or, if consistent with security, outside it, in order that the horses may not have to pass amongst the store cattle in the yard; and it will always be of advantage that it should face the south-east. No hen-roost or piggery should be in close proximity to the stable. Fowls are particularly objectionable, for there have been numerous instances in which the apparent mange of the horse has been traced to the pest that inhabits the skin of the feathered biped.

Cart-horses are occasionally put into a loose stable, without any divisions between them. There may be economy of space in this, but frequent accidents result in consequence of vicious animals kicking each other, whilst the strongest generally get the largest share of the provender. The expense of dividing their stables into stalls, or separating their stalls by means of poles hung horizontally, would, therefore,

be well repaid by the resultant advantages of security and quiet feeding. The *width* of the stalls should be five feet and a half at the least, in order to enable the horses to lie down or turn round without inconvenience. It will also be advisable to elevate the divisions near the head, so that strange horses may neither see nor molest each other. Loose boxes, or rooms, are an improvement on stalled stables.

Few objects are less attended to in building stables than the style and arrangement of the mangers and racks. These latter, according to the common practice, are needlessly extended across the upper end of the stall: much provender, by being drawn and trodden under foot, is frequently wasted, and, as the racks project forward, the seeds of the hay sometimes fall into the eyes of the horse, and occasion injury. Even in loose stables separate upright hay cribs are preferable; and the manger should always have divisions high enough to prevent the

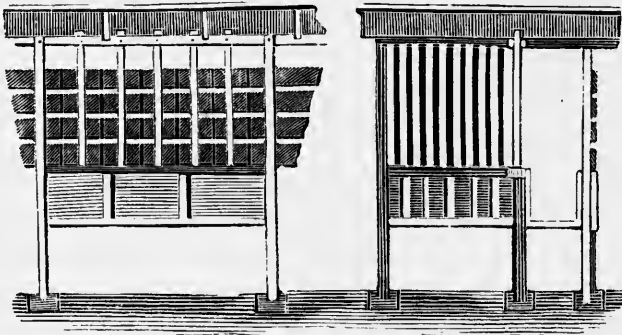


Fig. 208.

Fig. 209.

Stable Hay Wooden Racks.

horses from interfering with each other while feeding. In many of these stables the racks are much too large, especially as servants will fill them with hay, whatever may be their size. Many horses either devour fodder ravenously, or waste a great portion of it. It would be a convenience and a protection if the mangers were movable. They could then be occasionally cleansed from the dried saliva which accumulates about them, and the spread of infectious diseases would often be prevented. Every manger should have a sparred or perforated bottom for holding the tares and clover whilst permitting all the hay-seeds to escape, and a close one for the corn and mashes, or for any steamed food that may be occasionally employed. The stable for the saddle-horses should be at a small distance, or at least separate, from that appropriated to the cart-horses. The construction of these stables, however, scarcely comes within the scope of this treatise. In whatever way the corn-bin may be constructed, it should have a secure lock. A small space or room should always be partitioned off, and fitted with shelves and pegs for the reception of spare harness and various stable utensils, and for small articles not in constant use,



and which may be kept there in readiness, but always under lock and key.

Equally useful and economical, with reference to the food, are the

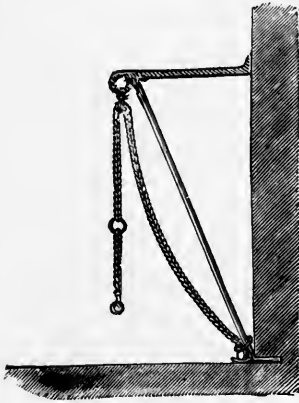


Fig. 210.

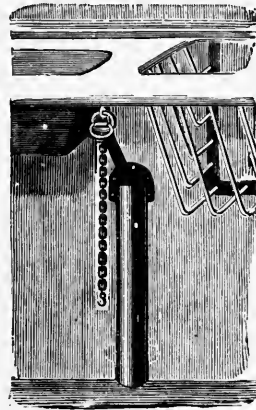


Fig. 211.

Methods of Tying Horses in Stables.

racks of the stables. The engravings on p. 678 will explain their construction. Fig. 208 is the elevation, and fig. 209 represents a transverse section, of the stall. The upright *slats* prevent the horses

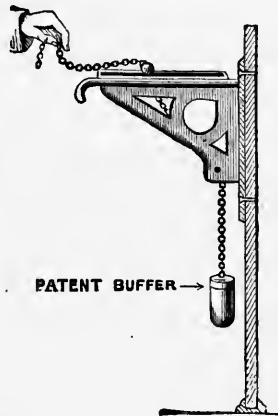


Fig. 212.—Horse Tie with Buffer.

from wasting the hay, as well as from blowing on it, and they cannot thrust their heads over the whole trough, but must feed fairly on the portion before them.

A method of tying common in cart-horse stables is seen in fig. 210. A strong wrought-iron bar is fixed at the bottom end into the wall or

floor, and at the top end to the manger. A ring runs up and down this bar, and through it a chain, rope, or strap works with a weight attached.

Another halter-tie (fig. 211), made, as is the preceding one, by the St. Pancras Ironworks Company, is protected by an iron casing, which

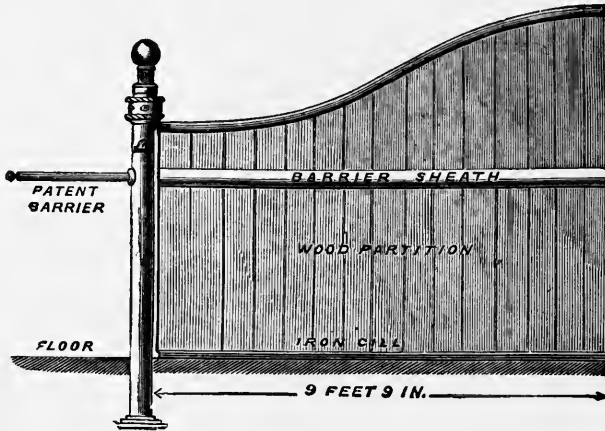


Fig. 213.—Stable Travis or Stall Division.

excludes straw and dirt. It cannot get out of order, and is perfectly noiseless; the part accessible to the horse is of chain and cannot be gnawed; and it is securely fixed to the wall and not to the manger. If a horse hangs back he cannot make it stick, but the weight returns immediately, so that there is no risk of the horse getting his legs over it.

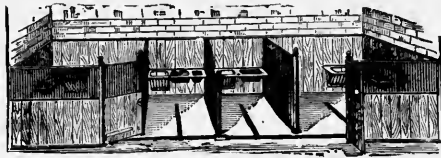


Fig. 214.—Stable with Two Stalls and Two Loose Boxes.

In fig. 212 is shown Messrs. Musgrave's "tie" for securing the horse to the stall. In fig. 213 we illustrate the form of "travis" or stall division made by the same firm; this is provided with the patent "barrier sheath," into which the barrier rod slides; by pulling this out, the stall can at once be transformed into a loose box.

In fig. 214 is shown a stable, fitted by Messrs. Bayliss, Jones and Bayliss, Wolverhampton, with two stalls and two loose boxes. The stall divisions are  $9\frac{1}{2}$  to  $10\frac{1}{2}$  feet long from wall to heel-post, and  $4\frac{1}{2}$  feet high to rise of ramp: the plain division consists of heel-posts, sill, and ramp-rail, all of which are fitted to receive boarding  $1\frac{1}{2}$  inch

thick. The stalls are 6 feet wide. Fig. 215 is the ground plan, on a larger scale, of the same stable. The arrangements may, of course, be varied indefinitely, with either stalls alone, or loose boxes alone, or both combined as here shown.

The manger fittings in these stables are entirely of iron. Some

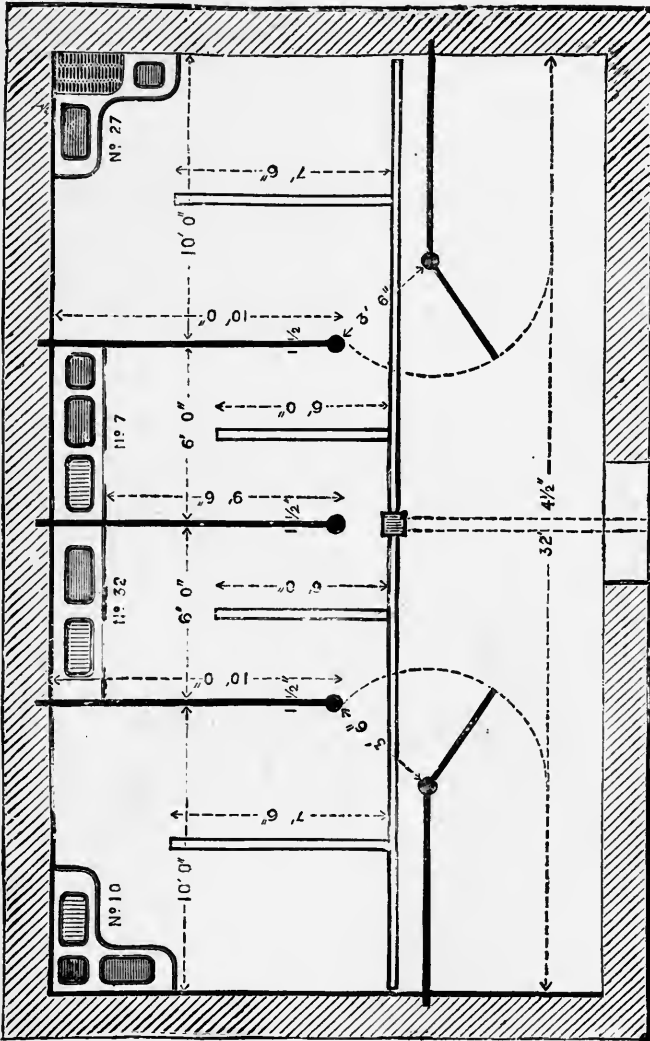


Fig. 215.—Plan, on Enlarged Scale, of Fig. 214

variations of those employed are illustrated on a larger scale in figs. 216 and 217.

A different arrangement as to fittings is shown in fig. 218, repre-

senting a stable of five stalls and one loose box, as erected by the St. Pancras Ironworks Company. Some horse-keepers prefer the hay-

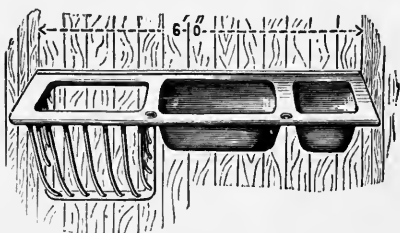


Fig. 216.

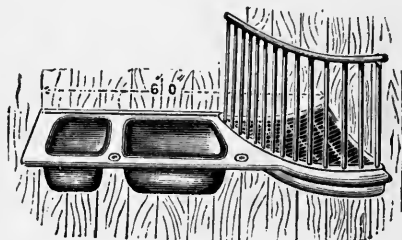


Fig. 217.

## Manger fittings.

rack in the position it occupies in these stalls, rather than higher or lower.

The *pavement* of most stables is laid too slopingly. This is for the

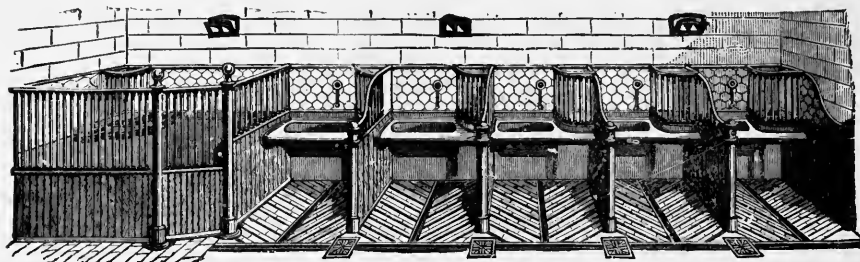


Fig. 218.—Stable of Five Stalls and One Loose Box.

purpose of draining off the urine more quickly and completely; but it often places the horse in a painful position, and the object may be equally well attained by grooves or channels lined with some non-retentive substance. Fig. 219 illustrates a grooved flooring brick well adapted for stables, &c.



Fig. 219.—Stable Floor Brick.

Even on the farms where corn husbandry is chiefly practised, large *barns* have ceased to be considered essential; and where dairying or cattle-grazing chiefly prevails, they are of still less moment, since it is now well known that grain, properly stacked in the sheaf, will keep as well, if not better, in the yard. Wherever it is necessary to erect new barns, care should be taken to make the floors dry and firm, for which purpose oaken planks are preferable to any other material, especially if the intention is to use it as a threshing-floor, but as the flail is now rarely, if ever, employed, concrete or asphaltum more commonly takes the place of wood. There should also be a sufficient number of apertures, through which hay and straw may be housed, and the barn should be placed immediately adjoining the

rick-yard; many of the inconveniences that would otherwise result from drawing loaded vehicles into the barn would thus be avoided.

The *Granary* should be adjacent to the barn, and may be constructed with advantage in the roof of that building, immediately over the threshing-floor, by which means the corn may be hoisted up when ready to be stored, and let down into a waggon drawn underneath when wanted for use, without the labour of carrying out. It is also more secure from depredation. The usual mode in some districts, however, is to erect the granary upon pillars in the stack-yard, it being thereby rendered safer from the attacks of vermin. As windows may be opened on either side, it can always be kept well ventilated. These openings should either be latticed or wired, so as to admit a frequent current of air. The granary should also be provided with bins for the separation of the different kinds of grain, as well as with conveniences for the storage of sacks, sieves, and measures; and, above all, with good

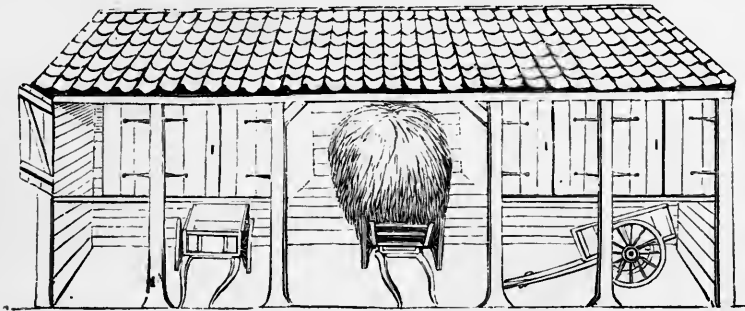


Fig. 220.—Tool House, or Implement Shed.

fastenings. The girders, the joists, and the floor should be close, firm, and strong. The inside should be lined with deal or oak planks, closely united together; the outside encased with strong weather boarding, well covered with pitch or tar varnish, every now and then repeated; and the roof well tiled. A little money expended in the perfect construction of this building will not be thrown away.

When grain has been stored for any length of time, particularly if in large quantities or in warm weather, it is much exposed to attacks of that destructive insect, the grain weevil. It is also liable to heat, and to acquire a musty smell. The only preventive is to keep it well aired, and frequently turned, and screened. For this purpose, constant ventilation is necessary, and the floor of the granary must be capacious, clean, and smooth.

Among the smaller farm-buildings, which are worthy of more notice than is usually bestowed upon them, is the *cart and tool-house* (fig. 220), for the reception of the waggons and implements, which, when not actually employed, are often heedlessly left on the spot where they were last used. This house consists chiefly of woodwork. The building allotted to the purpose should be so contrived as to afford

adequate shelter from rain, while the implements are exposed to a thorough ventilation. Hence an open spot, free to every wind, should be selected. The roof should be supported on pillars, high enough to admit a loaded waggon, and containing lofts for the storing of light implements, sacks, or other spare articles, somewhat in the way represented by the illustration.

As the only object, however, of these houses is to preserve the carts and tools from exposure to wet, this can be attained by mere sheds, the most economical mode of erecting which is to project a roof from the back of a barn or stable, and, if possible, immediately fronting the road into the yard.



Fig. 221.—Rick-Cover, with Pulley and Stay Ropes, Blocks and Tackle.

Fig. 221 shows the ordinary rick cover for use during the building of stacks: without doubt such a cover prevents very great loss during showery times. Another light covering for roofs is the "Willesden paper:" a waterproof felt which, considering its lightness and cost, is really very valuable. We have seen houses of which the side walls and roof were covered with this substance, and they have stood intact for years with no other repairing than a coat of paint.



Fig. 222.—The Redcliffe Rick-Cover or Thatch.

Galvanized iron has been introduced on the farm to a remarkable extent, and for temporary and even lasting purposes it is, despite its unsightliness, extremely useful. The Redcliffe Iron Works Co., Bristol, have introduced a convenient method of covering or thatching stacks by means of sheets (fig. 222),

fixed on to the roof by a patent pin. Those who have used them speak highly of them, and as both wheat-straw and thatchers are getting scarce it is only reasonable to expect that the system will extend. Messrs. Pearson, of Wolverhampton, have adapted galvanised iron to almost every purpose of covering required on the farm, among which may be mentioned silo covers, rick covers on iron and wooden columns, cart and cattle shed combined, sheep shelters, whole home-steads for various kinds of farms, manure sheds, cottages, &c.

*Calf-pens.*—In many parts of the country it is the practice to appropriate a portion of the cow-house to the reception of the calves: a measure which cannot fail in producing uneasiness among the cows, who, when not suckled, often withhold their milk in consequence of the bleating of the young animals. Hence, unless for the purpose of suckling from the dam, it is obviously preferable to have the pens at such a distance from the feeding-house that the cows cannot hear the noise of the calves.

The construction of these buildings is so simple and so well understood, that a particular description is deemed unnecessary. They should be latticed, so as to ensure ventilation and admit fresh air, as a moderate and rather cool temperature should at all times prevail in the calf-pens containing the animals that are to be reared. Those that are destined for the butcher should be kept warmer. Light, too, should be particularly excluded from the latter, as darkness inclines all animals to rest, and the quieter calves are kept the better they will thrive. The strictest cleanliness should also be observed, and every effort made to promote dryness and sweetness; the floors should be boarded and perforated, so that the urine and excrement may pass into a reservoir beneath; and, if possible, the pens should open either into the stack-yard, or the orchard, or some small and quiet enclosure, in order to afford an opportunity of occasionally turning out calves that are intended to be reared. Each calf, whether destined for rearing or slaughter, should have a separate pen.

When the profit arising from the rearing of swine is duly considered, and there is an opportunity of prosecuting this branch of rural economy to any considerable extent, it will be admitted that the establishment of a *Piggery* demands nearly as much attention as a dairy.

The piggery should be constructed with due regard to warmth and dryness, and divided into various sections for the reception of the swine, according to their age and breed. Each division should be six or seven feet in width, of such a height that the largest pigs can comfortably enter, and provided with a small yard or area sufficiently capacious to hold the feeding troughs, so that the swine may be conveniently fed without any need for the attendant to go in amongst them. The piggery of a small grazing farm, however, may consist of a certain number of little sheds, opening to small yards, and disposed of in any part of the range of buildings that may be most convenient. Two details must not be forgotten, namely, that every sty should have a *rubbing-post*, as few things contribute so much to the cleanliness and thriving of the pigs, whilst from every sty a drain should communicate with the manure pit or tank. Convenient troughs should be so arranged that offal, milk, &c., may be conveyed into them from the milk-house, or scalding-house, by means of pipes. Pigs often thrust their feet into the troughs, and thus waste a considerable portion of food, but this may be avoided by fixing some rods in a frame over the troughs, not unlike a rack; or a thin piece of plank may be nailed on the back part of the troughs, and so project as to allow the heads only of the animals to enter.

The same object may also be attained, when swine are put up to fatten on dry food, by fixing a conical hopper (holding any convenient quantity) in the trough, with the broad end upwards, and covered with a strong lid. At the lower end should be an aperture for giving

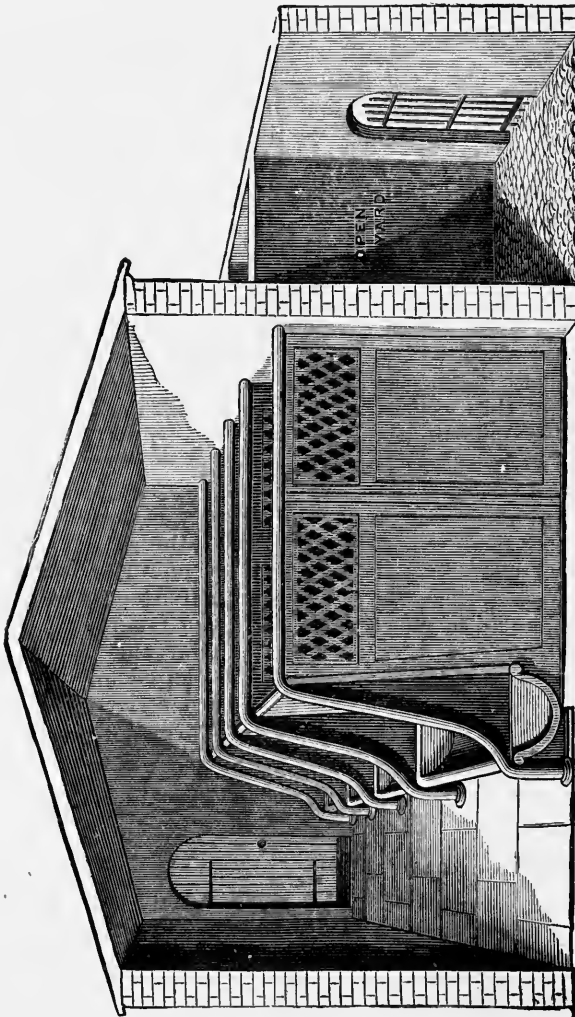


Fig. 223.—Musgrave's Brick and Iron Piggery.

out the food into the trough, where the animal may eat it as it falls, without being able to spoil or waste any portion of it. By adopting this expedient, the farther advantage will be derived in fattening swine, that, by feeding more leisurely than in the usual mode, their food will probably be more thoroughly masticated. This will contribute to their larger and quicker growth, and likewise to the good



quality of the meat. Farrowing pens should always be provided where pig-breeding is practised. Sows are so liable to lie on their young during the first few days after birth that some protection is necessary, and this is best obtained by running a bar round the sty sufficiently

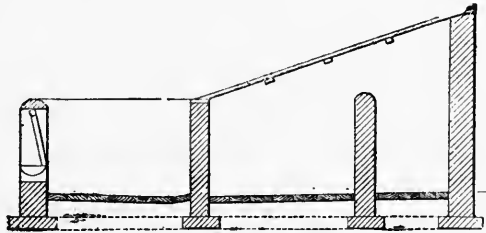


Fig. 224.—Section of Piggery.

high for the young pigs to creep under, and about a foot from the outside wall. Fig. 223 illustrates Messrs. Musgrave & Co.'s mode of erecting and fitting-up of piggeries.

It is always desirable to place the feeding-trough altogether outside

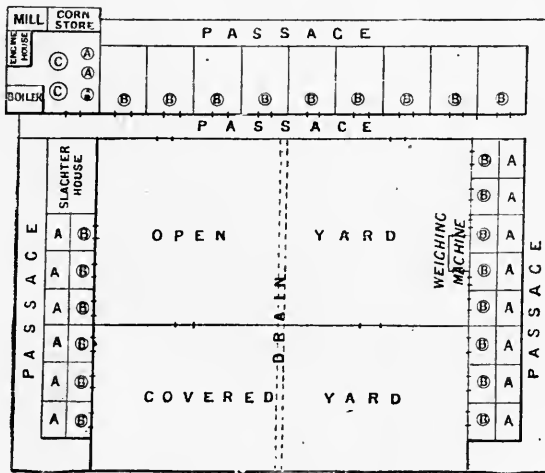


Fig. 225.—Arrangement of a Piggery.

A, movable wooden stages for pigs to lie upon ; B, cast-iron feeding troughs ; C, mixing-tubs.

the sty, as in the section of the piggery shown in fig. 224. The feeding-troughs are so arranged in the front wall that by raising or lowering a flap door the pigs can be admitted to, or shut off from, the troughs. The flap doors, when hanging perpendicularly, shut the pigs from the food, but when swung back and fastened by a button to the front of the trough, permit the pigs to feed. There ought in every case to be a passage (fig. 224, p) between the back wall and the interior division

running from end to end of the piggery, so that the covered pen may be kept clean and well littered, and in order that the pigs can be seen when desired.

The plan in fig. 225 shows the arrangement of the principal piggery of Mr. Tommas. The sties are built on three sides of the yard, with the south side open, so that they are sheltered from the cold winds, and the mid-day sun shines into the centre yard. There is a passage all round with sliding ventilators, which are opened or closed according to the weather. The doors in front also have slides. The building materials are brick and timber. The floors are laid with blue bricks,

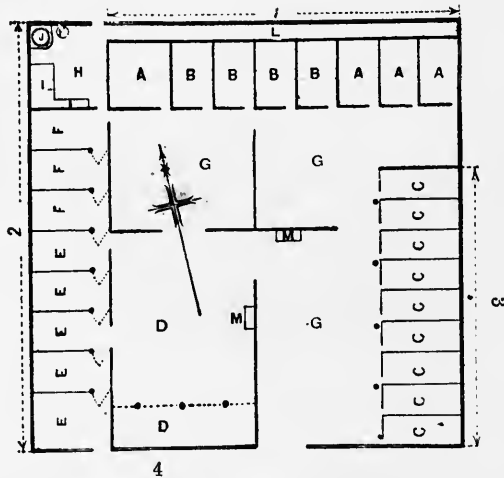


Fig. 226.—Piggeries at Clapham Park Farm, Bedford.

A, farrowing sties. B, sties for young pigs. C, sties for boars. D, shed and yard for sows in pig. E, boxes for pigs or calves. F, boxes used for farrowing or for sows with litter. G, feeding and exercise yards, brick-paved. H, boiling-house. I, steaming apparatus and flour-bins. J, egg-shaped boiler. K, copper furnace. L, passage. M, water-troughs. Sheds marked 1 and 2 are enclosed. Sheds marked 3 and 4 are open in front.

set on edge in cement, so that the water runs off and the floors cannot be rooted up. For the large breed, Mr. Tommas considers the best size of sty is about 16 ft. by 10 ft., a size suitable for a large sow and family, or for six large ones for feeding or rearing. About one-half of the sty is raised by a stage made of common planks, on which the litter is spread. In each sty there is a cast-iron trough, about 2 ft. in diameter, of the shape of a saucer, which the pigs cannot upset, and which is easily cleaned.

In the piggeries at Clapham Park Farm, Bedford, of which a plan is shown in fig. 226, the troughs are in the feeding yards, not in the sties, and each pen of pigs is let out to feed separately. The following description of them was given by Mr. James Howard, in the "Journal of the Royal Agricultural Society":—"My piggeries are upon a well-drained site with a southern aspect: they have plenty of fresh air and

light, and are distinct from the other premises. Ample provision exists for warmth and shelter in winter. While some persons prefer asphalted flooring on account of cleanliness, the smoothness and hardness are objectionable. Wooden spars absorb urine and accumulate dirt. On the whole I prefer a floor of hard gault bricks laid with cement. At the rear of the piggeries a portion of a field has been fenced off and used as an exercise ground for the breeding sows and other stock pigs. As it is difficult to provide for yard exercise where a number of stock boars are kept, these are placed in sties sufficiently large to give them as much exercise as they need. Boars under nine months old have a regular turn of yard exercise each day. The question of exercise for young boars is a very important one, as of course nothing will so much



Fig. 227.—Pig Trough.

conduce to the development of their legs and feet, which are such important organs in the male animal.”

Fig. 227 illustrates a form of circular pig trough, manufactured by Messrs. Ransomes, Sims, and Jefferies, Ipswich. This will be found useful in pig-courts; the divisions prevent the pigs from disturbing each other when feeding.

*Root Houses* are valuable where the cattle are fed much on turnips, mangel, carrots, potatoes, &c. These may be piled up in order to be near at hand for daily use. The root-house should be kept clean and sweet, for the roots are apt to rot or ferment; and if there is the slightest unpleasant smell or taste about them, the animals may be disgusted and refuse to feed. It is desirable that the root-house should adjoin the feeding and cooking houses, or be incorporated with the latter. Where very large quantities of roots are fed they are often clamped in some place conveniently near, and carted out as required.

The practice of steaming food is by many good feeders considered to be necessary. Cooked or steamed food helps to keep up the temperature of the animals if fed when hot; it is also conducive to rapid and sweet fermentation when mixed with other coarse foods. Fig. 228 represents one form of Messrs. Barford and Perkins's boiling

and steaming apparatus, which will be found well suited to its purpose.

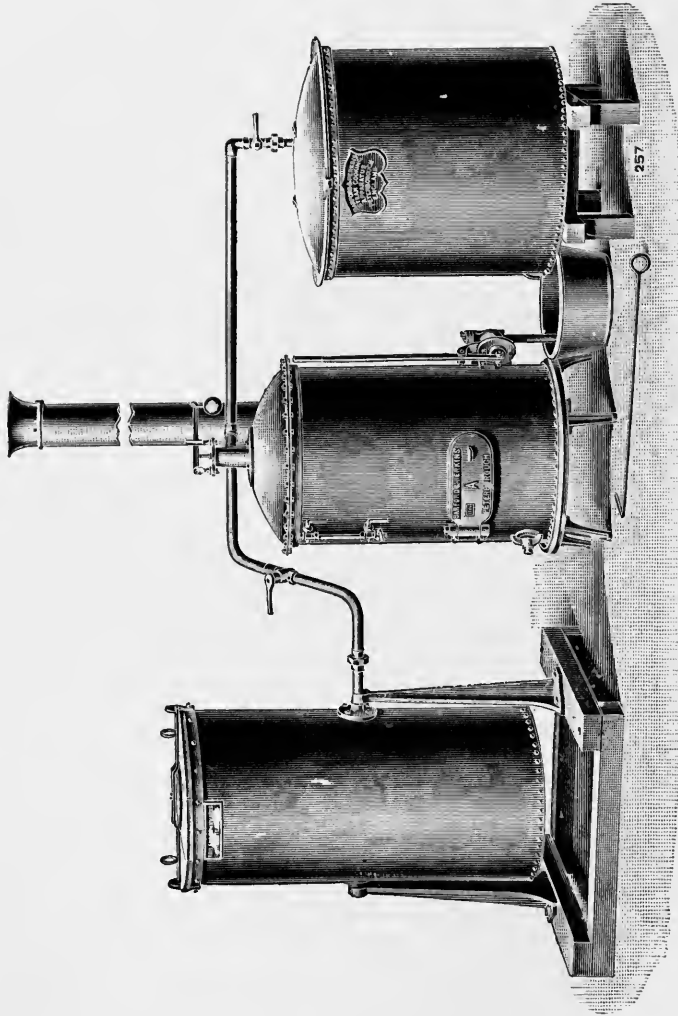


Fig. 228.—Improved Boiler Steaming and Cooking Apparatus.

Messrs. Barford and Perkins, of Peterborough, have for a long time paid special attention to food-preparing machinery, and have succeeded

in obtaining a high reputation for the machines they turn out. In fig. 229 a model set of their food-preparing machinery is shown, whereby all the various methods for preparing food can be accomplished under cover. The power is obtained from one of their vertical engines, from

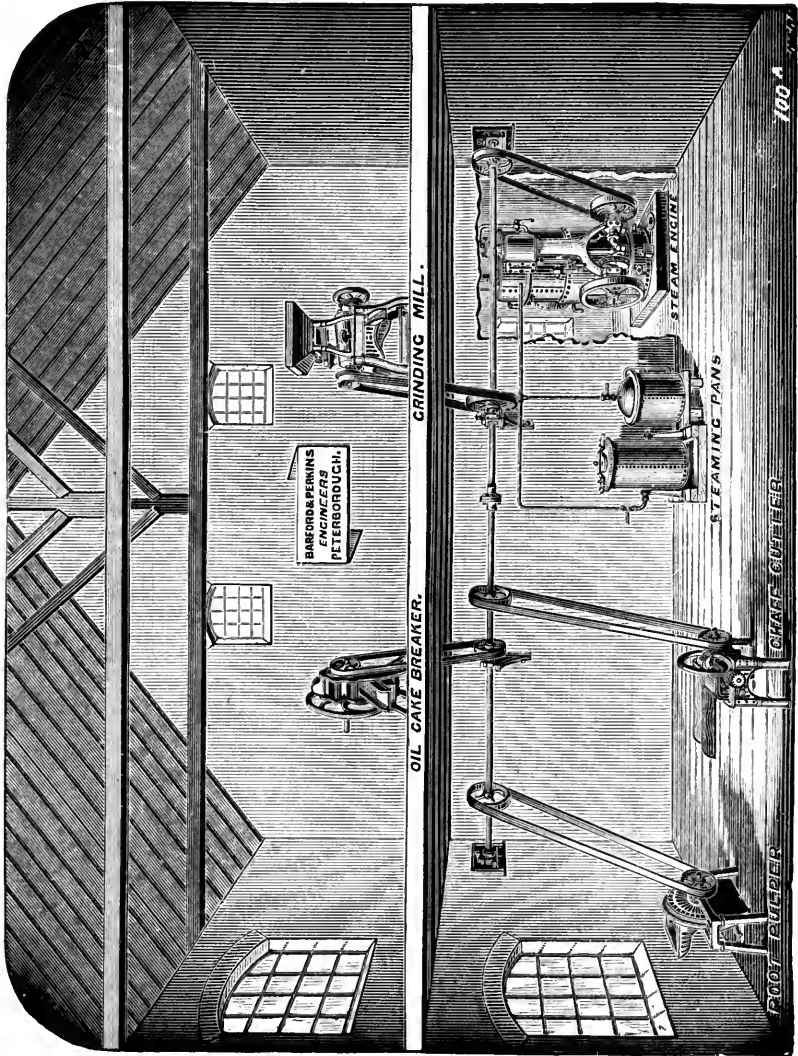


Fig. 229.—Messrs. Barford and Perkins's Set of Food Preparing Machinery.

the boiler of which a pipe conveys the steam to the cooking apparatus. By means of one long shaft the machines on the upper and ground floor can be driven simultaneously. The cost of fixing and maintaining the shafting is thus very small.

On large farms where a big head of stock is kept, the ordinary iron

steaming apparatus is not large enough to meet all requirements if the whole of the animals are fed on steamed food, and something more commodious has to be arranged. Mr. Harry Horrell, of Thorney, who always keeps a large number of Shire horses as well as of cattle, has two wooden bins eight feet three inches long, six feet six inches wide, and five feet six inches high, which will make up 200 bushels each. The steam is obtained from a stationary vertical engine near. He finds that rough hay, cavings, or any other coarse food, may be made palatable and useful feeding stuff. Mr. Horrell's remarks on the system are worth notice, he says:—"I like the steaming apparatus, especially for young cattle. I find if you steam long enough they will do without any roots, and certainly graze better in the spring for the reason that if cattle have plenty of roots in spring they will shoot their hair, and



Fig. 230.—Root-Washing Machine.

then when turned out they are much more likely to take cold, whereas if fed on steamed chaff they do not shed their coats."

The washing of potatoes or roots may be conveniently effected by means of the machine illustrated in fig. 230, which consists of a cylinder composed of open laths, placed in a trough filled with water, and turned by a winch-handle. There is a small opening in the centre for the admission of the roots, which are delivered at one end as they are washed, and roll down the spout to the vessel placed to receive them.

*Pounds* are found in almost every village, for the reception of strayed or trespassing cattle; but they are capable of being applied to more useful purposes, and may be so arranged as to serve four or five adjoining farms. In case of accidents to neat cattle, or when the latter have to undergo any examination, pounds will be found advantageous, and much loss of time may frequently be prevented by their use.

*The Stack-yard.*—It is less the custom than formerly to stack the corn in the stack-yard, for horses cannot always be spared to cart the corn far from the field in which it grew. It is an undoubted fact that corn is better when stacked in an open place, free to every wind that blows, than it is when crowded into a stack-yard where one stack shelters another from sunshine and breeze. It is, moreover, safe to stack corn in a much moister condition in the open, than in a crowded stack-yard, where it cannot dry before the March winds begin to blow, and when probably the musty smell will not be got rid of.

*Forge.*—Many outlying farms are placed at a disadvantage because there is no forge conveniently near, so that all little repairs have to be done at a distance: a small forge is therefore most useful. Messrs. Samuelson & Co. are makers of the blower and hearth illustrated in fig. 231, and it would be difficult to find a more useful appendage to the homestead.

Besides the various buildings, &c., that have been specified, it will be proper to have loose boxes or separate apartments for the reception of sick or diseased cattle. These should be erected in some quiet spot contiguous to the farm offices, but at such a distance as to prevent the healthy beasts from being affected by contagion.

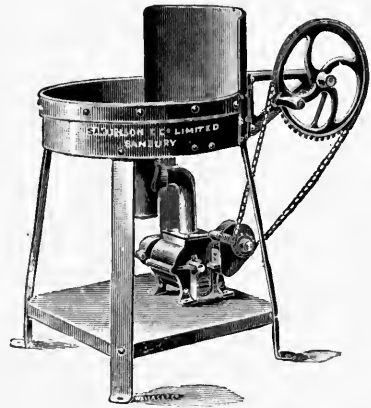


Fig. 231.—Root's Improved Acme Forge.

## CHAPTER II.

### ON THE CONSTRUCTION OF PONDS.

**T**HERE is nothing of greater importance to the health of domesticated animals than a constant supply of water, which, being the only liquid horses and cattle are accustomed to drink, should be perfectly pure. The superior quality of water has been supposed to be indicated by its clearness, and by its continuing transparent notwithstanding the application of chemical tests. It is not, however, the clearest water that is necessarily the most wholesome. There are few

things which so soon, and very frequently so thoroughly, produce temporary, and sometimes, permanent, derangement of health in the horse as the hard, although beautifully transparent, water of some wells.

Well water is necessary for domestic use. If it has been filtered through beds of gravel it is the more wholesome. A brook running through the farm is a great acquisition, for it is usually free from those saline admixtures that diminish the wholesomeness of the well water; but it is not every farm that possesses such a stream, nor is the access to it always easy or safe. In some districts the farmer must depend principally on ponds for the supply of his different stock; and if they are not apt to vary too much in the quantity of water which they contain at different periods of the year, and if the access to them is over a gravelly or stony descent, whilst they are not surrounded by any marshy ground, no danger need be apprehended in connection with them.

The farmer will usually find one or two ponds in his grounds; but if he has to make fresh ones, he will, if he can, select the bottom of a gentle declivity, or a corner where two or more fields meet together, by which means not only will a regular supply of water be procured after rain has fallen, but it will be possible to water the cattle with less waste of time and of ground.

The descent to the ponds should be covered with gravel or stones; or, if the descent is necessarily over clay, there should be no vegetation within two or three yards of the water. Such ponds will rarely give sheep the rot; but where the pond is surrounded by marshy ground, or the vegetation grows to the very brink of the water, or almost or quite on a level with the pasture, there is considerable risk.

Clayey soils are mostly selected for the ponds, and, generally speaking, they will answer tolerably well; indeed, the stagnant water of a pond, in order to be wholesome, should stand on a clay or chalk bottom. These reservoirs, however, are apt to crack and become leaky after a hot summer, and then the farmer may be compelled to make an artificial pond.

In doing this, the pit should first be dug to a convenient depth. For one of forty feet in diameter, five feet is a sufficient depth; or it may be enlarged to seven if the pond is sixty feet in diameter. If the situation will allow it, a reservoir may be constructed for the reception of the waste water. That portion of the water which is intended for the use of cattle will thus be preserved in a state of greater purity, while the sediment that will from time to time be collected in such reservoirs may be easily drawn thence, and converted into an excellent manure. The sides of the ponds should be carefully sloped to an angle of about forty or forty-five degrees. One main point in the economical construction of ponds, is to render them *perfectly retentive of water*.

This will be best accomplished by lining the pond four inches thick with lime concrete, then with six inches of well beaten clay, firmly pounded into a compact bed, and lastly with a coating of stone neatly



packed on edge, and carefully finished round the rim of the pond, where it may be covered with gravel.

Such a pond is kept supplied with surface water, conducted into it by shallow gutters running down from higher ground.

It is important that a regular supply of water should be conveyed to the different yards attached to the farm-house. Where there is a running stream this may be easily effected, otherwise there must be a reservoir in the highest part of the homestead.

The annexed illustration (fig. 232) shows the outline of a pond for soils where there is a scarcity of water, of which description there were many in the county of York, before these ponds were introduced. We direct attention to it on account of its ingenuity, and its perfect success, and because it may supply a valuable hint to those needing ponds.

The line A represents an excavation, made in the ground, of such dimensions as circumstances may require. On this a stratum of clay, B, is carefully beaten and trodden until it becomes a solid compact

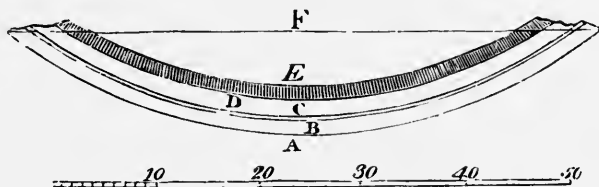


Fig. 232.—Section of a Watering Pond.

mass, from four to six inches in depth. The line C indicates a layer of quicklime, about an inch or an inch and a half in thickness, which is also uniformly spread over the whole. D is a second stratum, or bed of clay, which is likewise from four to six inches in depth, and beaten and trodden down as before. The letter E designates stones or gravel, either of which must be spread on the second bed of clay, to such a thickness as will prevent the pond from being *poached* or injured by the feet of cattle, and consequently save the water from being discharged through the pores of the earth. F delineates the line of level both of the ground and of the water; and, when thus finished, the pond will be about five feet deep, and forty-five in diameter. The expense of constructing ponds of this size is stated to have been in former times from 4*l.* to 6*l.*, according to the distance the clay had to be carted. We suspect, however, that these sums would be nearly trebled at the present day. Reservoirs thus formed will remain unimpaired for many years, as the lime prevents worms from striking either upwards or downwards, and, of course, from damaging the clay.

The most simple kind of pond is that in which the water stands in a gravel bed near the surface, for then it is only necessary to excavate, as the water will rise into the hollow so long as the springs continue high enough.

Ponds have been conveniently classified as: (1) those maintained by main springs, (2) those maintained by land springs, (3) those which

are mere drains, and (4) those maintained by condensation,—the so-called “dew ponds.” Examples of the second class are afforded by the ponds which exist at high elevations on Chalk Downs, and which are remarkable for the persistency with which they defy evaporation. They are formed in, and maintained in water by, a superficial covering of sand or sandy clay, which is apparently the argillaceous base of the Thanet sand, or, where it is absent, of the Woolwich and Reading Beds (Eocene) left adhering to the chalk. This argillaceous sand may plainly be seen in and around the successful ponds, which often have

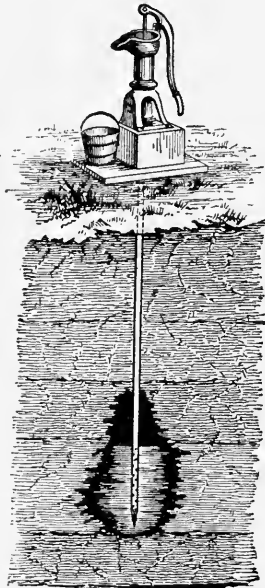


Fig. 233.—Abyssinian Pump.

old names. On the other hand there are numerous cases of puddled ponds, resting upon bare chalk on the Downs, which are dry for months together. As to the distinction between main springs and land springs, it may be premised that a spring involves the existence of water at a higher level in the rock from which it flows. Land springs are shallow springs due to rain falling on soils, and confined to waters contained in or issuing from such soils, or from superficial deposits of sand, gravel, or clay, or other deposits which constitute the “surface geology.” Land springs are chiefly of interest to the agriculturist, many villages being still wholly dependent upon such. Main springs arise from the water contained in, or issuing from, all rocks constituting the “solid geology.” They are chiefly of interest to the engineer, though not entirely so, for many of the most successful ponds depend upon main springs.

Abyssinian pumps may be used with great advantage in cases where the water lies near the surface. Of course, it is necessary to pump the water before the animals

can drink, but the pumps and troughs are inexpensive, and take up very little room. In establishing an Abyssinian tube-well, the tube is driven into the ground until its perforated end reaches a stratum containing water. The liquid will then flow through the perforations into the pipe, so that, if a pump is attached at the upper end of the tube, by pumping for a time all the particles of sand and fine gravel will be drawn out, and the cavity thus formed will remain filled with pure water, as shown in fig. 233.

A very good way of utilising a spring from higher ground is to convey the water by means of pipes to a convenient place, and run it into a sunken trough, around which the ground has been made firm, so that it is not trodden up by animals. A single spring may be made to supply many fields, for if there are troughs connected by pipes for the water to run into, very little is required for each trough.

## CHAPTER III.

## ON FARM COTTAGES.

GOOD farm-cottages are very necessary to the welfare of all connected with an estate, for the landlord cannot let his farms freely unless there is a good supply of labour, and the farmer cannot pursue his business unless he has a call on a fair number of men; and without good homes men are very liable to be discontented with their lot, and are ready to leave the place for very little inducement. Farm hands are better in every respect for a good home, especially if it is surrounded by a convenient garden where spare time can be utilised, rather than wasted in loafing, or in frequenting public-houses. Men with the responsibility of a good house are doubtless better citizens than those who exist in inconvenient and comfortless abodes, and where it is impossible for them to live in decency, or in accordance with the first principles of sanitation. This has become recognised by almost every landowner, and cottages are now built on much more comfortable lines than in the past, so that the wretched hovels which were once considered good enough are rapidly passing away. The consequence is that farm-cottages are rarely built in the expectation of their becoming profitable investments in the first instance, though indirectly they may reasonably be expected to give a good return, and they are properly regarded as quite as necessary as any other portion of the stading, for without them the equipment of the farm is incomplete. Though money should not be wasted on them, the aim should nevertheless be to provide the greatest amount of room and comfort for the outlay incurred.

Some estates are noted for excellent cottages, but the latter have been rendered more expensive than was necessary by the introduction of useless gables, which frequently are not water-tight, and are costly to maintain. The more simple the cottage the better, unless it is the owner's wish to add to the picturesqueness of the landscape. It is very desirable that there should be a convenient out-house, to be divided into a closet and a store-room for the man's tools and other odd things, even if there is an indoor closet also. Land in the country is not of great value, and the cost of erecting such an out-house need not be great. When it is decided to build away from the farm-homestead and village, cottages should be erected in pairs, so that in time of sickness or accident one family may be able to render assistance to the other.

It is obvious that the scope of our work prevents our entering fully into all details. These, indeed, must be looked for in special treatises on the subject. In commencing to plan a cottage, it will result in some saving if the following points, too often lost sight of, are duly

considered :—first, the *extent*, and secondly, the *kind* of accommodation required.

The rule which has generally prevailed of making all cottages of equal accommodation is evidently wrong. Families vary in number, and houses should be built some suitable for large and others for small families. If all the houses are of the same size, and adapted in extent of accommodation for very large families, it is obvious that, where a family with few members inhabits one of them, an excess of accommodation is available, the cost of providing which is thrown away. There are, however, certain features of accommodation which must not be overlooked even in the smallest cottage, hence it is of importance to know what these are.

Mr. Roberts, an authority on all matters connected with dwellings for the labouring classes, says, with reference to the kind and extent of accommodation required in them, that this must vary with the means and circumstances of the occupants; but that the minimum of a cottage for a country labourer having children of both sexes should be “a small entrance lobby, a living room not less than 150 feet in area, a scullery of from 60 to 80 feet area, in which there should be a stove or fireplace for use in summer, as well as a copper and sink; there should also be a small pantry. Above should be a parents’ bedroom of not less than 100 feet superficial, and two sleeping-rooms for the children, averaging from 70 feet to 80 feet superficial each, with a distinct and independent access. Two of the sleeping-rooms at least should have fireplaces. There should also be a ventilated and well-drained closet (privy), and suitable receptacles for fuel and for dust. The height of the rooms, in order to be healthy, should be scarcely less than 8 feet, and even 9 feet would be desirable, but for the extra expense. With a view to ventilation, the windows should reach nearly to the ceiling, and the upper part be invariably made to open.” It is clear that a “hard and fast line” cannot be laid down in the case of cottages. Some families require much, others little, sleeping accommodation. Every cottage should have, however, a porch, to keep the living-room warm, a scullery, a privy, coal-place and ash-place, and cupboards—as many as possible.

In the choice of a site, where choice is at the disposal of the builder—not always the case, by the way—the preference should be given to that which is high and dry. Hollows, and plots at the foot of rising ground, should be carefully avoided. The soil best adapted to secure a healthy site is gravel; heavy close clay is the worst. The *sunniest aspect* is the best; and this is obtained by having the front to face the south. Light, and plenty of it, is an essential to a healthy cottage. We have already alluded to the drainage of the site; this being properly attended to, the sinking of the foundation should be carefully effected. It will be well to dig out the whole area to be covered by the cottage to a depth of at least 2 feet; this will secure dry floors. The dug-out area should be extended at least 24 inches beyond either line of walls, the space being filled up and well rammed with clinkers or dry smithy cinders, or, if these are not obtainable, small pieces of

broken bricks or small stones. If the site is not drained, and the soil is inclined to be damp, the footings should be laid in concrete, the depth of which should not be less than 12 inches. A layer of slate laid in gas-tar or prepared felt, round the whole wall above the ground level will also prevent damp, or Taylor's foundation hollow bricks may be used. The walls should be of hollow bricks, or, if these are not used, what is called a "cavity" wall should be made. A hollow wall conduces greatly to warmth and dryness, and should be adopted in all cases.

Where floors are made of earth, tile, or brick, the plan already recommended of digging out the whole area enclosed by the walls to a depth of 2 feet, and of filling it up with cinders, &c., will secure dryness of the floors. But the healthiest of all floors is a boarded one, to protect which from dampness it should be raised at least 18 inches from the ground level; this will raise the entrance two steps above the level. The joists on which the flooring boards are supported should be made to rest upon small brick piers carried up from the ground. This mode of construction will tend to secure freedom from dry rot. Of materials for roof-covering, tiles are the warmer in winter, the cooler in summer, and are more economical than slates.

Much has been written about the sewerage of cottages, more especially with reference to the carrying away of the liquid and solid refuse of the inhabitants. Doubtless good sewerage has its advantages; but, upon the whole, it is open to doubt whether it is worth while carrying out in isolated cottages, or even in rows of three or four cottages, any elaborate scheme embracing the laying down of drain tubes, water-closets, or stench-traps, and involving also the risk of stoppages, with their attendant train of nuisances. To make the drain-tube sewerage system perfect, a constant and liberal supply of water is essential, and this also at some pressure. This, in country places, is not usually obtainable, unless by erecting cisterns at a higher level than the closet and sinks, and pumping the water up to these cisterns. For houses concentrated in villages sewerage is sometimes a necessity, particularly when some of the cottages have little or no gardens. The sink-water and other liquid refuse must be got rid of in some way; but for the rest the earth-closet system is by far the most sanitary. As a rule, where cottages are isolated singly or in sets of two or three, the sink-water can be drained away into a ditch at some distance from the dwellings, while more objectionable liquid refuse may be emptied on to a dunghill or bare ground in a remote part of the garden. If the dwellers cannot be made to use a proper earth-closet, at least they should be induced to use ashes or earth in the privies. A cesspool for sink-water may be necessary in some cases; but it should be avoided, if possible, and when it is necessary it should be placed at some distance from the dwelling, and emptied frequently. Large and foul cesspools are common causes of illness.

The agricultural literature of recent years abounds in examples of cottage plans; and so numerous indeed have they become, that a volume of selections could with great ease be made up from them.

As it is somewhat difficult to choose where choice is so wide, we must content ourselves with giving one or two examples only, with suggestions as to their improvement or modification.

The provision of any particular class of cottage being decided upon, together with the kind or class of construction, as single-storied or two-storied, the changes may be rung—so to say—upon these to almost any number of tunes; so that one or two good examples will enable the reader, if directly interested in the subject, to draw up a series of plans showing different arrangements of the same accommodation till he at last arrives at one likely to meet his requirements. Cottages are either single-storied or two-storied, and these may be erected singly or isolated—termed detached, or in pairs—termed semi-detached, or a number in line—termed rows.

In fig. 234 we show the arrangement of a single-storied detached

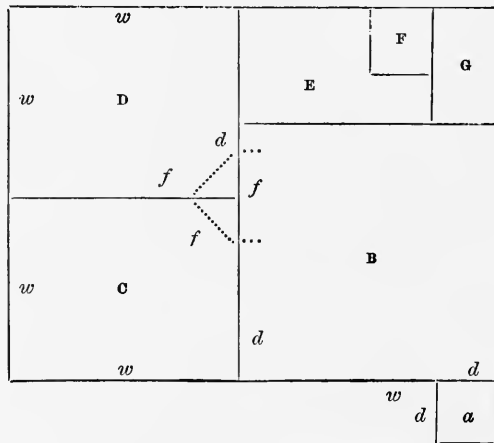


Fig. 234.—Plan of Single-Storied Detached Cottage.

cottage, in which *a* is the porch; *B* the living-room, 10 ft. by 14 ft.; *c* bed-room, 8 ft. by 7 ft. 6 in.; *D* bed-room, 8 ft. by 10 ft. 6 in.; *E* rain-water tank, *F* coal store; *G* water-closet; *w* positions of windows, *d* of doors, *f* of fireplaces. In this plan both bed-rooms are entered through the living-room, a most objectionable arrangement, and there is no scullery. A capital scullery might have been obtained by taking the coal store and privy to the back, and giving the space *E F G* to a scullery, entered from the living-room *B*. By putting the porch in the centre wall, nearest the front wall, an independent entrance might have been obtained to the living-room *B* and bed-room *c*, and the second bed-room *D* might have been entered from the scullery, which, as we have intimated, could have been placed in the space, *E, F, G*.

In fig. 235 we give the ground plan (exhibited at the Leeds competition of cottage plans) of a detached cottage (two-storied) in which *A* is the living-room, 13 ft. by 12 ft. 6 in.; *B* the porch or entrance;

C the pantry ; D the fuel store ; E the scullery, 10 ft. by 9 ft. ; F space for stairs leading to chamber floor ; G dust and lumber place ; H water-closet or privy. The door-spaces are marked *d*, windows *w*, and *f* shows the position of fireplaces. In fig. 236 we show the bed-room plan of this cottage, in which A and B are the front and back bed-

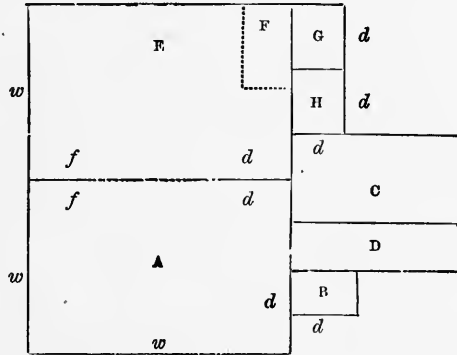


Fig. 235.—Ground Plan of Two-Storied Detached Cottage.

rooms, G the stairs, E small bed-room. In this type of cottage the objection to the ground-plan arrangement is that the scullery has to be reached by passing through the kitchen, or by going round to the back, and the bed-rooms can only be reached by passing through the

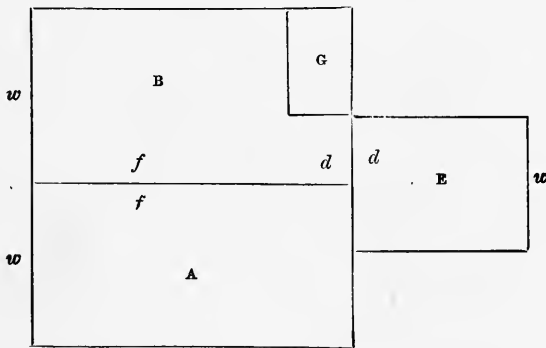


Fig. 236.—Upper Floor of Cottage (Fig. 235).

scullery. The fuel-place is too far away from the fireplaces, and the privy too near the pantry. In the bed-room arrangement, the great objection is that there are no independent entrances to the rooms. This could be obviated by carrying forward a partition separating the staircase G from the bed-room B, and thus leaving an isolated landing-place, from which independent entrances could be obtained to all the three bed-rooms.

In fig. 237 we give another sketch-plan of a pair of cottages (two-storied, "semi-detached"). A is the porch, B the living-room, c the scullery, D the wash-house, E the stairs, entering the living-room at the end *h*.

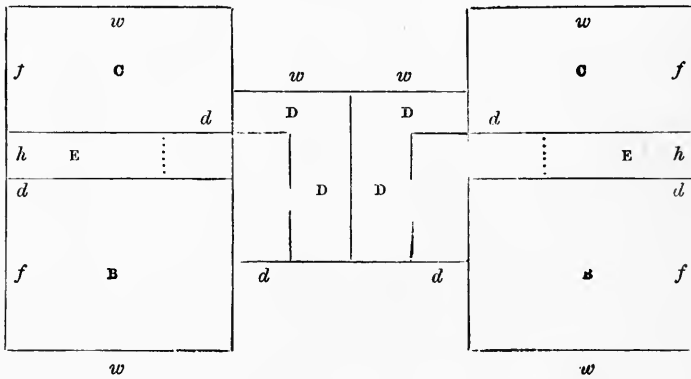


Fig. 237.—Plan of Pair of Two-Storied Semi-Detached Cottages.

In fig. 238, the bed-room plan, *a* is the position of stairs, *a'* the landing from which, through independent entrances, admission is obtained into the three bed-rooms, B, c, and D.

The accompanying plans (figs. 239 to 243) are those of stone-built cottages erected in Northumberland. They are four-roomed cottages, finished in substantial style. Each cottage has its own backyard quite

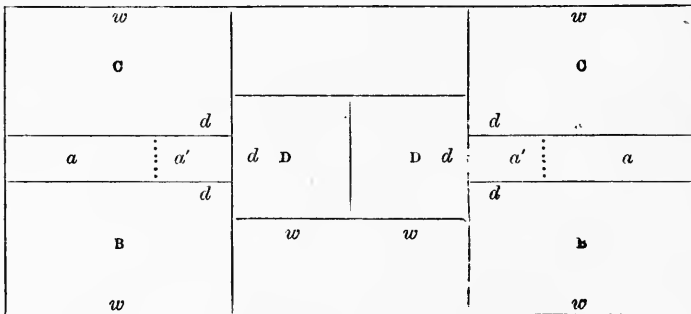


Fig. 238.—Upper Floor of Two Cottages (Fig. 237).

separate from the adjoining yards, and the outhouses abut upon a lane affording access to carts. Fig. 239 shows the ground plan; fig. 240 chamber plan; fig. 241 front elevation; and fig. 242 back elevation. Fig. 243 is the section through A B in fig. 239. The actual cost of these cottages was from 124*l.* to 138*l.* each. It is probable that the cost of such cottages at the present time would be considerably higher than it was when they were erected.



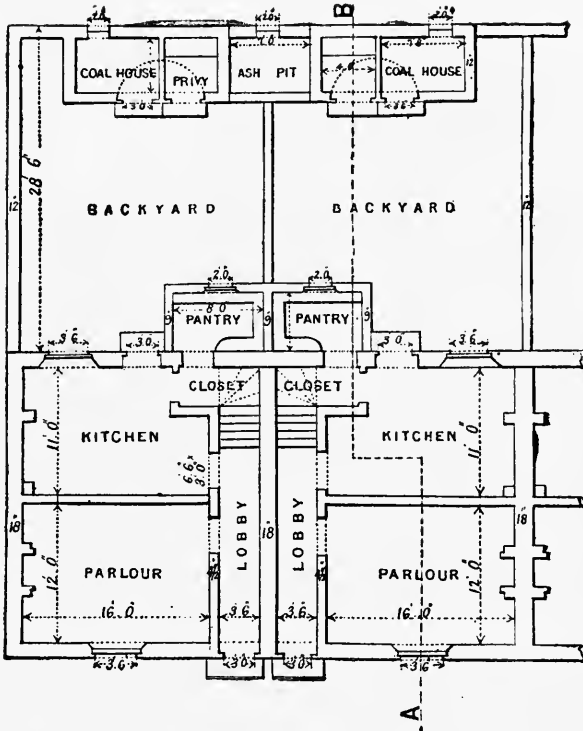


Fig. 239.—Ground Plan of Cottages.

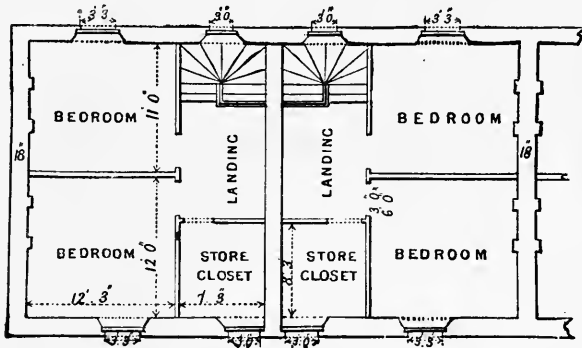


Fig. 240.—Upper Floor Plan of Fig. 239.

Bricks were supplied to the contractor at 20s. per 1000 by the landowner. Plans of the cottages are seen in figs. 244 to 249.



Fig. 241.—Front Elevation.

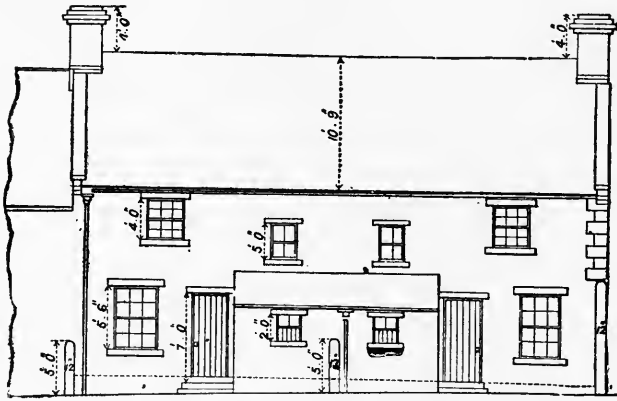


Fig. 242.—Back Elevation.

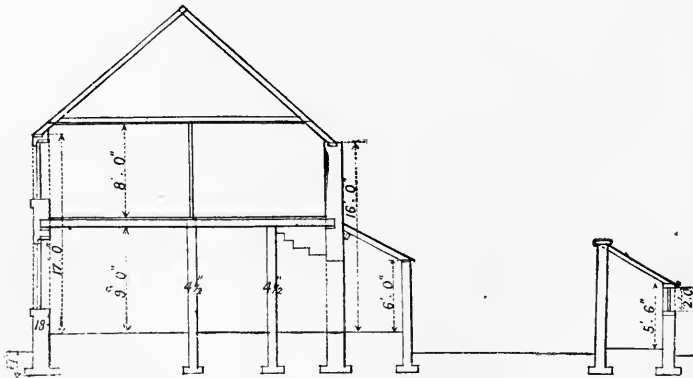


Fig. 243.—Section of Cottage.

Cottages of all sizes and varieties may be made of corrugated iron. An example is shown in fig. 250. All the apartments are floored,

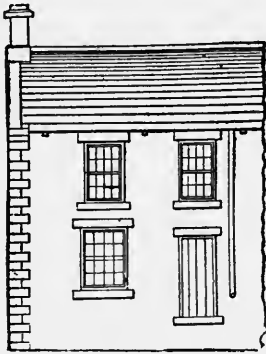


Fig. 244.

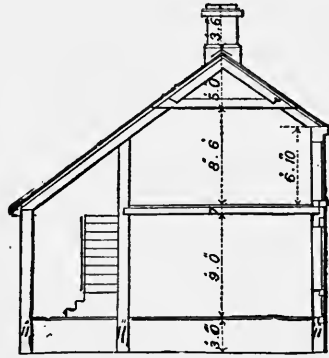


Fig. 245.

lined, and ceiled with wood, and finished with wood cornices. Stoves and presses are provided suitable to the size of the house, and

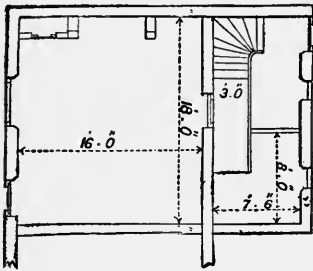


Fig. 246.

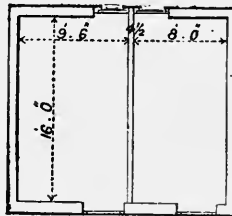


Fig. 247.

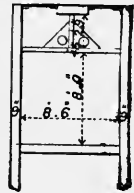


Fig. 248.

scrupulous attention is bestowed upon sanitary arrangements. In the thaw following a severe frost, the water from the melted ice beneath



Fig. 249.



Fig. 250.—Corrugated Iron Cottage.

the roof is liable to find its way through the fissures in the matchboard of the ceiling.

In Garden City cottage-building competition in 1907, Mr. C. M. Crickman, of Lincoln's Inn Fields, London, and Letchworth, was awarded the medal in three classes. The stipulation was that every winner should be bound to reproduce a number of cottages, if required, at the prices entered in the catalogue of the Exhibition. Mr Crickman's prices per cottage for cottages in pairs in the two cheapest classes were as below:—

1. Living room, scullery, covered space, larder, coal-house, a good bedroom, and two other rooms, 165*l*.

2. Parlour, large kitchen, scullery, and three rooms upstairs, 187*l*.

Mr Clough, winner of the medal in the class for cottages for small holdings, priced his dwelling at 165*l*. He said he saw his way to building a double-tenement cottage, four rooms and outbuildings for each tenement, at a cost of 220*l*.

Landowners are sometimes in a position to build cottages at lower prices than contractors would charge them. According to an article in the *Times*, Mr. Keeble, a West Norfolk landowner, has erected a number of six-room cottages of attractive appearance at an average of 105*l*. 10*s*. 1*d*. He possesses, however, a private railway, which greatly reduces the cost of the transport of materials.

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## CHAPTER IV.

### ON FARM IMPLEMENTS. PLOUGHS—HARROWS—CULTIVATORS.

**T**HE plough demands notice first, as it is generally the first used in tillage operations. This implement has passed through many forms. The one most commonly used of late years was considered to be practically perfect, but the recent introduction of the new digging-breasts has shown that in the case of most soils there was room for improvement, and farmers are rapidly availing themselves of the light and effective plough now in the market.

The object of ploughing is to turn the land over in order that the subsequent workings may be rendered more easy; to present a fresh surface to the influence of the weather; to bury manure, stubble, or any other growth; and, on heavy land, to lay it up in ridges so that the water may run off into the furrows more quickly. The plough consists of guiding-handles attached to the main beam, which carries, in most cases, the body with the mould-board and share, the coulter, the skim-coulter, and the cross-beam. To the last-named are fixed the standards or legs, on which are the axles of the wheels. Modern ploughs are made chiefly of steel, but occasionally local prejudice clings to wood, and in such cases makers are obliged to continue to use it. Mould-boards of

particular construction are used locally in many districts, where the orthodox turn-over mould-board has not been found to suit the land so well; but there is great probability that the new type of digging-breast will supersede them, though perhaps only gradually. There are several

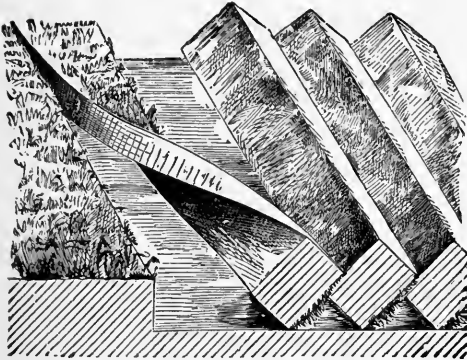


Fig. 251.—Rectangular Furrow, Unbroken.

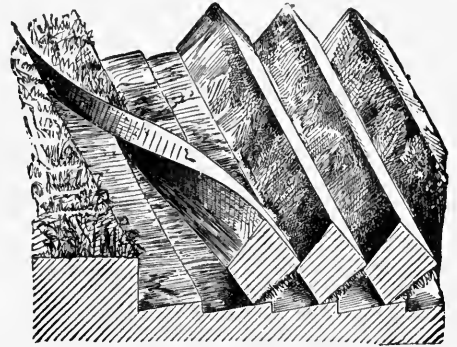


Fig. 252.—Crested Furrow, Unbroken.

forms of furrow turned, of which the rectangular (fig. 251), the crested (fig. 252), and the wide broken furrow (fig. 253), are the most general.

As the soils of farms are of various kinds, ploughs are correspondingly diversified in their construction, and in the purposes to which they are applied. We have only space to notice a few of the implements that are most deserving of attention.

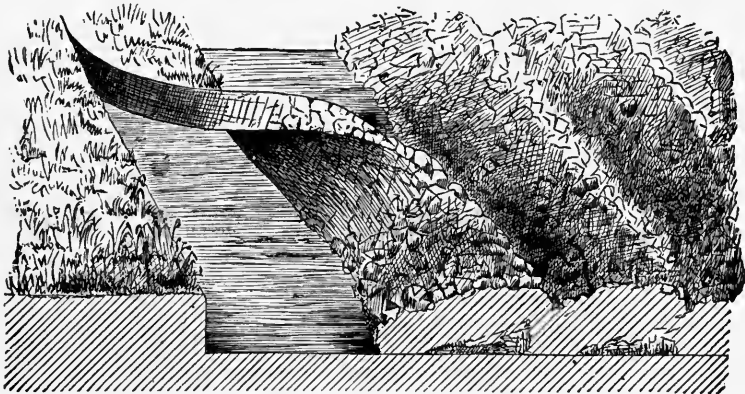


Fig. 253.—Wide Broken Furrow.

The ploughs in most frequent use are *wheel ploughs*, and *swing ploughs*, the latter being not provided with wheels.

It is necessary to set the plough so that it runs evenly on the slide, and unless it is desired to make the crest very high, as in the trapezoidal

furrow, the bottoms of furrows should be cut off flush with one another. The great object to attain is that the furrow side of the slice shall not be deeper than the land side, for this causes the subsoil to be broken out, thus bringing up, in many instances, obnoxious weeds and inferior subsoil; moreover, it adds very much to the horse-labour, as, instead of the furrow being cleanly cut by the share and coulter, so as to only need turning over, there is a piece to be broken and lifted out. The trapezoidal



Fig. 254.—Ransome's Swing Plough.

furrow is the easiest to turn, but others, leaving a level horse-walk, are the best for drainage purposes.

Swing ploughs have long been and still are the favourites in Scotland and the northern districts of England, although many wheel ploughs of English make are being gradually introduced, and are to be met with in districts where but a few years ago not one was to be seen. This would

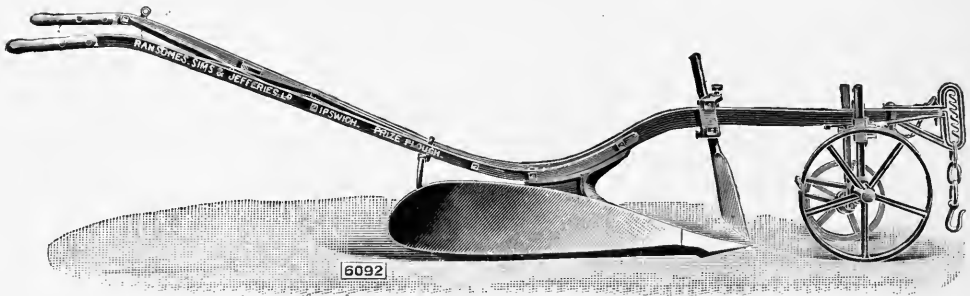


Fig. 255.—Ransome's Wheel Plough.

seem to corroborate the view suggested in the next sentence. The distinction would appear to be that, for well-cultivated lands, free from stones and obstructions, the wheel plough is the best; while for those lands which abound in stones, which are greasy when wet, so that the wheels clog, and which are not what are termed free-working soils, the swing plough is more generally used. However, wheel ploughs are more simple to hold, and, except on land where it is impossible to run them,

they are bound ultimately to take the place of swing ploughs. The latter differ but little from wheel ploughs, save that the handles are made longer in order to give the holder more control over the implement, for he has to perform two duties which the wheels discharge—to regulate the width and also the depth of the furrow. Fig. 254 shows

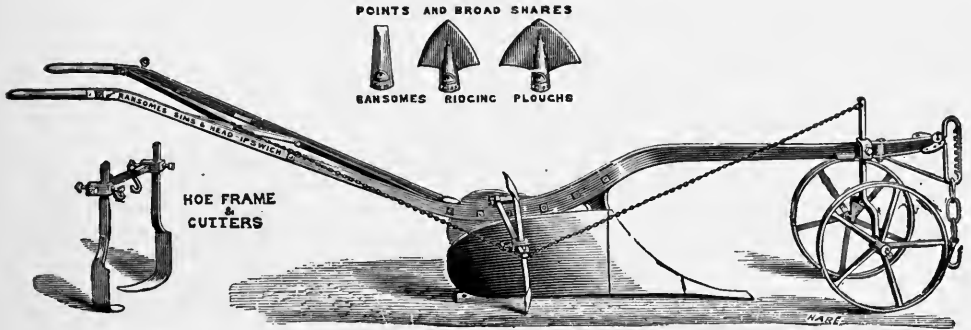


Fig. 256.—Ransome's Double Mould Board or Ridging Plough.

the greater length of handles to beam in the swing plough, as compared with those of the wheel plough (fig. 255).

In fig. 256 we illustrate the double mould-board plough for forming ridges in turnip and potato cultivation. It may be made into a single-row horse-hoe by taking off the mould-boards and attaching a cross-beam to

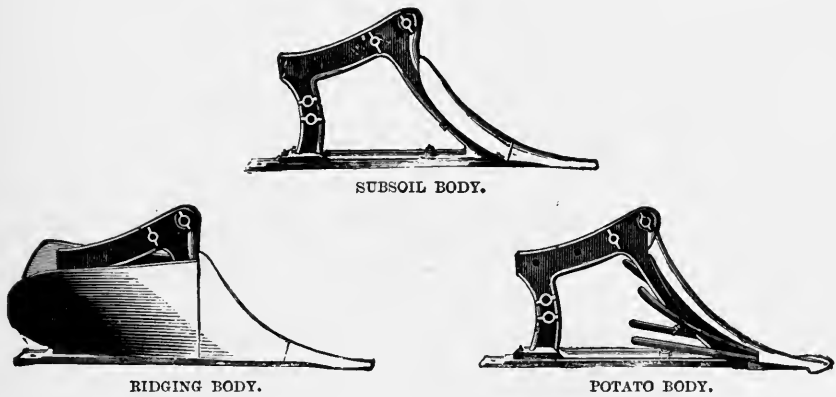


Fig. 257.—Extra Bodies to Fit on Ransome's Ridging Plough.

carry hoes. Separate bodies are made, as seen in the illustrations in fig. 257, to convert it into a subsoiler, or a potato-digging plough.

Fig. 258 illustrates one of Ransome's double-furrow ploughs. It is strange that these are not more used on light soils, as they certainly economise both horse and manual labour. In some districts, notably in the medium and lighter fens, they are much employed.

The multiple plough (fig. 259) is a very useful implement for paring stubbles after harvest, or for turning over tilths. These ploughs economise labour, and deserve more attention than they receive.

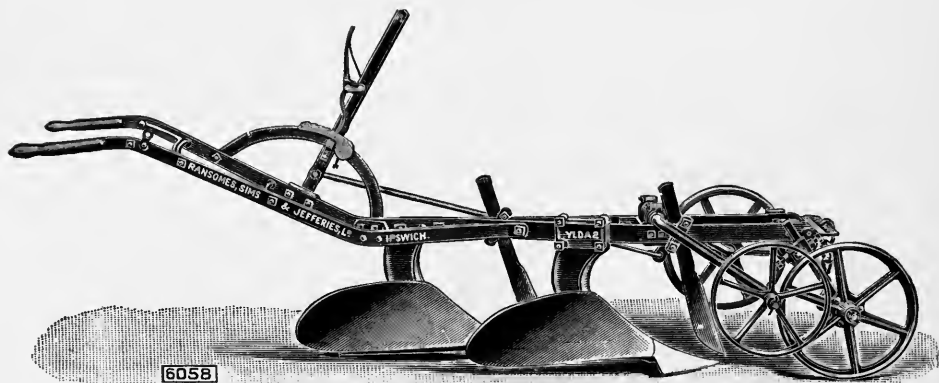


Fig. 258.—Ransome's Double-Furrow Plough.

We come next to a new type of plough which is known under various names, such as the digging plough, the steel-chill plough, and the Anglo-

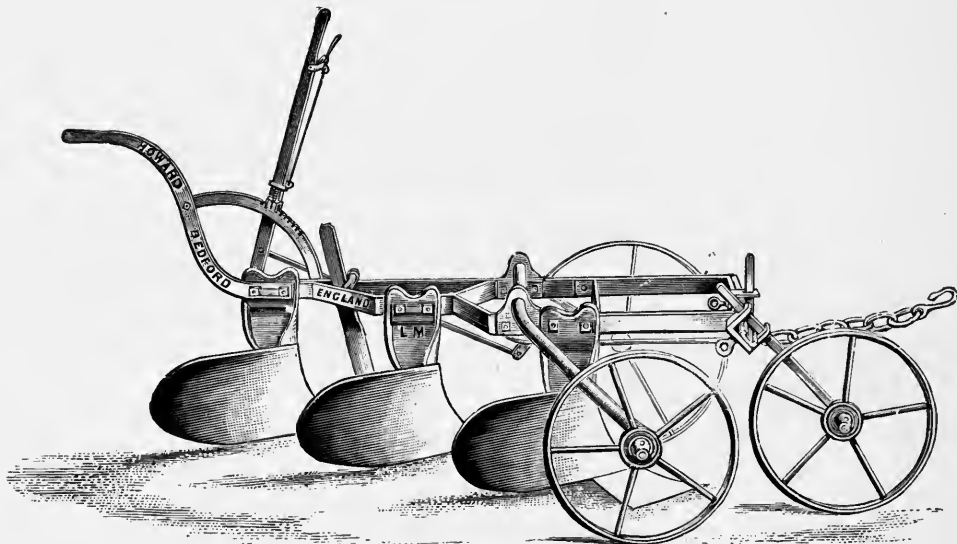


Fig. 259.—Howard's Multiple Plough.

American plough. As is shown in fig. 260, the mould-board is shorter than in the ploughs which we have already illustrated. The longer mould-boards are made so as to invert and compress the furrow, leaving



it with a sharp crest: the new plough inverts the furrow, but by the somewhat dished form of the mould-board, throws the mould out loosely, much as is done by the spade, leaving it light. It is safe to predict that



Fig. 260.—Ransome's New Iron "Steel-Chill" Plough.

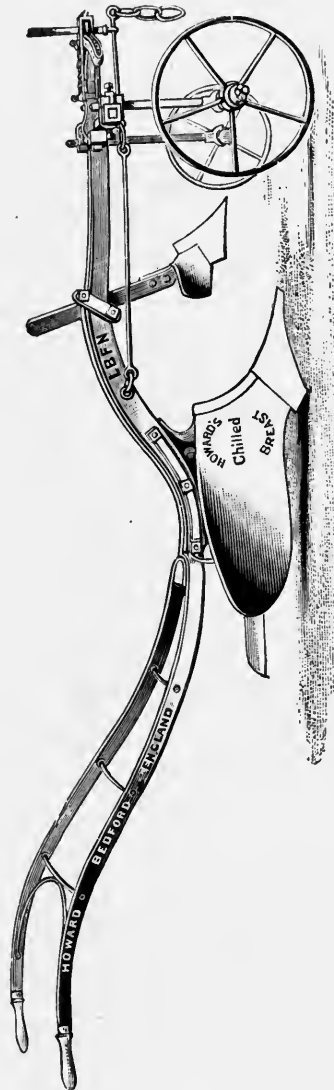


Fig. 261.—Howard's Steel-Beam Chilled Breast Plough.

in course of time this plough will supersede the older kinds on all but the heaviest land, and already, though there has been a great prejudice against it, it is gaining favour on the heavy soils.

The plough illustrated in fig. 261 shows a strong frame with a share

which has an acute point, suitable for hard land ; another form is in great favour with market-gardeners and other cultivators of lighter soils, as it is light in construction, and is fitted with a chisel-pointed share, which makes it run steadily. Both are provided with a spreader behind the mould-board, to level down the soil when it is turned, but this can be removed if desired. These ploughs will turn a furrow fourteen inches in breadth, and nine inches deep, if required ; and at any depth they need no more than two-thirds of the labour required by the ordinary ploughs, working at a corresponding depth. A narrow furrow is essential on almost all soils when the common plough is used, but the looser nature of the furrow turned by this, caused by its falling over without compression, makes the narrow furrow no longer necessary, whilst a broad furrow is advantageous.

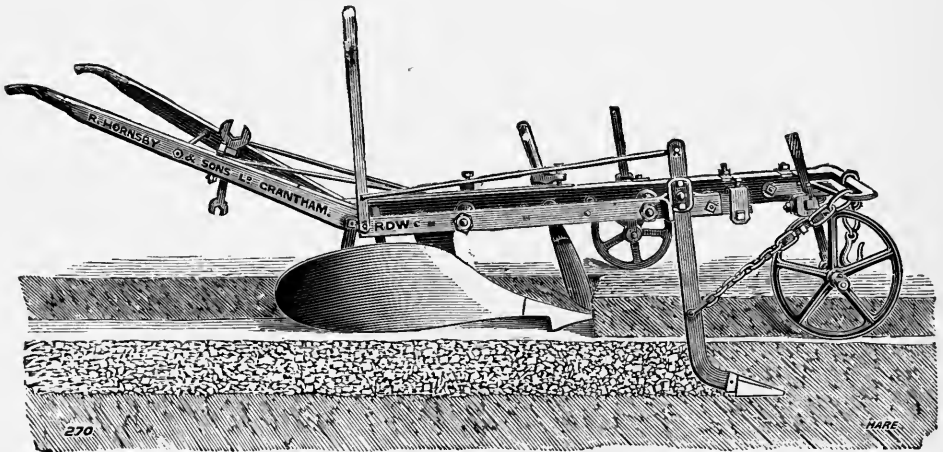


Fig. 262.—Hornsby's Double Furrow Plough, with Sub-soiling Attachments.

These ploughs may be made in the multiple form, and it is worthy of note that the great plough-making firms have made the bodies so that they can be fitted to the beams of their ordinary ploughs with the greatest ease ; hence there is every inducement to farmers to adopt them.

When land has been ploughed at one and the same depth for a considerable time, and on account also of other causes, the subsoil becomes very hard, forming what is known as a pan. This prevents the water from draining through, and thus injures the crops ; it is therefore necessary to break it. But as subsoils often contain injurious matter, they must not be brought to the surface, so that the ordinary plough is useless, and a special implement—the subsoil plough—is required.

Fig. 262 shows a double-furrow plough in which one of the mould-boards has been replaced by a subsoiler. It will be seen that the subsoiler is working in the horse-walk, while the mould-board is turning a furrow on to the freshly-stirred subsoil ; if the draught is too heavy, a single-beam subsoiler can be used, in which case it will have to follow the plough directly.

There are many other ploughs suitable for different purposes, but those we have illustrated are good representatives of the implements commonly used on arable land. It is worth while, however, to call attention in this work to the gripping plough, which is of great value on grass land.

The gripping plough is intended to open up water-furrows on grass land, and the construction of the mould-board is such that the turf is cut out cleanly on both sides and deposited well away from the grip. This is impossible with an ordinary plough, by which only one side of the furrow is cut, thereby entailing much subsequent labour.



Fig. 263.—Howard's Balance Turn-Wrest Plough.

Many grass fields become seriously injured through accumulations of water which cannot escape without assistance; yet the depression is often in the form of a very shallow pan, and a slight gutter would be sufficient to relieve the surface of the stagnant water. Where the pan forms near to the side of the field, a short trench may quickly be dug with a spade, but when the pan is at a distance the work is slow and laborious. Water often accumulates at the bottom of ridges where the lands are laid up in ridge and furrow. The injurious effect of the stagnant water is soon noticeable, because the herbage becomes light and harsh, and large has-

socks or tussocks of *Aira cæspitosa* develop and render the field both unsightly and unprofitable. The fields require constant attention, especially when they are grazed, as the animals tread down the sides of the furrows and block them up. Where the soil is tenacious, especially if the field is flat, the gutters should be ploughed out every autumn, as well as on other occasions when found necessary.

The old wooden turn-wrest plough is still used to a considerable extent in Kent and Sussex. An adaptation of it, in iron, is in the form of a balance plough, as shown in fig. 263. This implement has two breasts, which are respectively put into and out of work by a lever, turning the furrow-slices all in the same direction, and leaving no open furrows. The disc plough, commonly used in the United States, has not yet come into use in this country.

Potato digging is expensive work, and in many districts it is very hard to find hands to do it, and there is great probability that this difficulty will increase. Efficient machines for digging are therefore likely to be in good demand, and the one illustrated in fig. 264 has proved very successful both in the show-yard and in the field. If potatoes are dug by hand many are injured by the fork, so that, though some may be crushed or cut by this machine, all of the injured ones must not be looked upon as a loss which would not have been occasioned had they been dug by hand. If the machine is properly worked, there

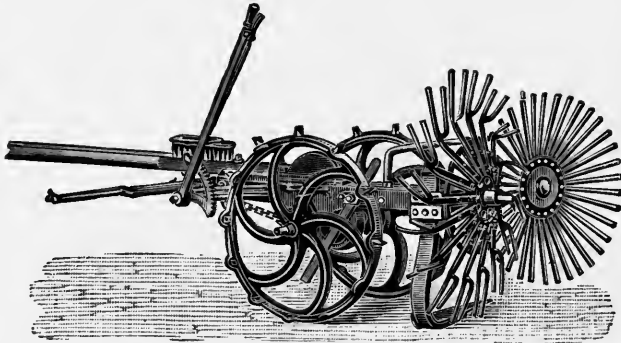


Fig. 264.—Powell Brothers and Whitaker's Potato Raiser.

is, in fact, very little risk of serious injury. It is a machine which gets through work quickly, and is superior to ordinary ploughs in that the ground is left level, thus greatly facilitating the picking up of the tubers, which is a very expensive item at all times. Many large growers of potatoes, however, still use the double-breasted plough, with prongs attached for raising the crop; and an adaptation of it is an implement, with an oscillating prong frame, manufactured by Messrs. Shores & Co., of Owston Ferry, by which the soil is sifted away from the potatoes to some extent.

We now proceed to notice other forms of cultivating implements in use on the farm, though it is impossible, in the limits of this work, to

notice all such forms. Fig. 265 is an illustration of Martin's patent cultivator, manufactured by Martin's Cultivator Co., of Stamford. This machine, which was awarded the first prize in the competitive field trials of the Royal Agricultural Society at York in 1900, has rigid tines, to which, however, elasticity is imparted by U-shaped springs attached to them, and to the guide-blocks on the frame. When the machine is at work, the springs keep the tines in a constant state of vibration, and, if the latter encounter a very hard piece of ground, the springs can be compressed only to the guide-blocks, so that the tines then have the extra rigidity necessary to enable them to pass through the obstruction

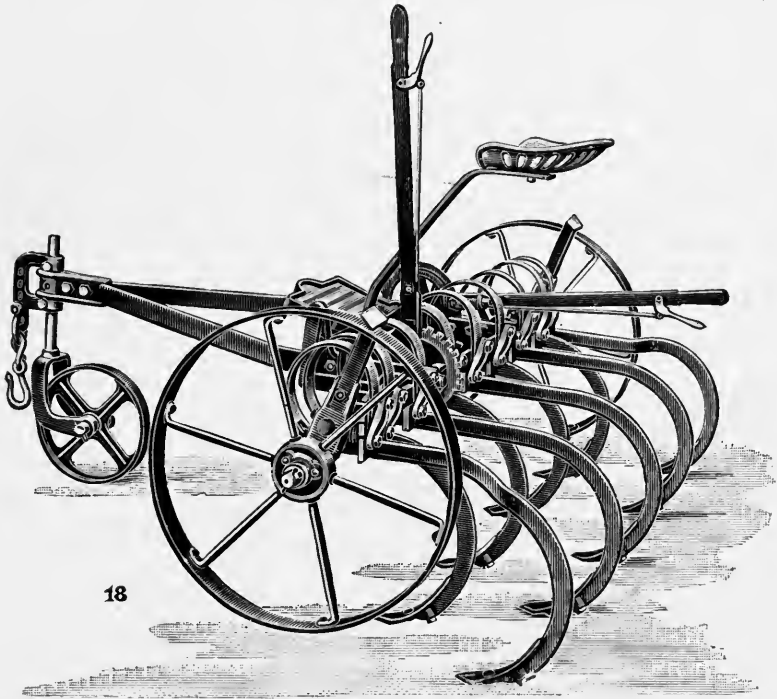


Fig. 265.—Martin's Cultivator.

more or less deeply. For some years, spring-tine cultivators, as opposed to implements which have rigid tines, introduced from Canada and the United States, had a great run in this country. Probably the best of implements of this type is the Massey-Harris cultivator (fig. 266), manufactured by the company of that name at Toronto, Canada, whose London agency is at 54 Bunhill Row, E.C. This excellent implement has become very popular in England. In common with some other cultivators, it can have a seed-box attached to it, as shown in our illustration, so that corn or seeds may be sown broadcast and covered in one operation. For the heavy soils common in this country, however, rigidity in the tines is

desirable, and after the type with rigid tines and springs was introduced in the form of Martin's patent, the preference of farmers turned in favour of it. Ransome's new steel cultivator, shown in fig. 267, has

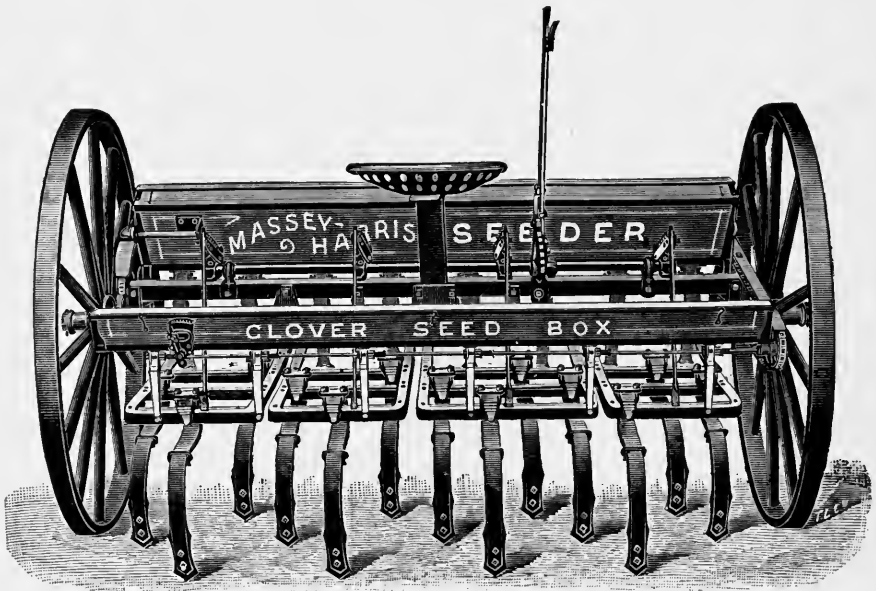


Fig. 266.—The Massey-Harris Cultivator.

rigid rectangular tines, the frame which carries them being in three sections. Each section has pressure conveyed through a strong spiral spring, which gives play to the sections in relation to irregularities of

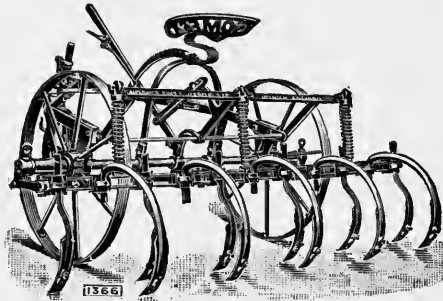


Fig. 267.—Ransome's New Cultivator.

soil. This implement is adaptable for use as a ridger and as a horse-hoe. As a ridger it makes two complete ridges and two half ridges in one operation. As a horse-hoe, the tines can be adjusted laterally to the desired width, and it can be set for three tines to work in each of

three spaces between roots or potatoes. There are many other excellent cultivators in the market. The old broad-share cultivators have gone almost entirely out of use. They were used to some extent for breaking up stubble; but the plough is the best implement for that purpose, except where a steam cultivator is available.

Cultivators are known by various names in different parts of the country, such as "scarifiers," "grubbers," "scufflers," and "shims."

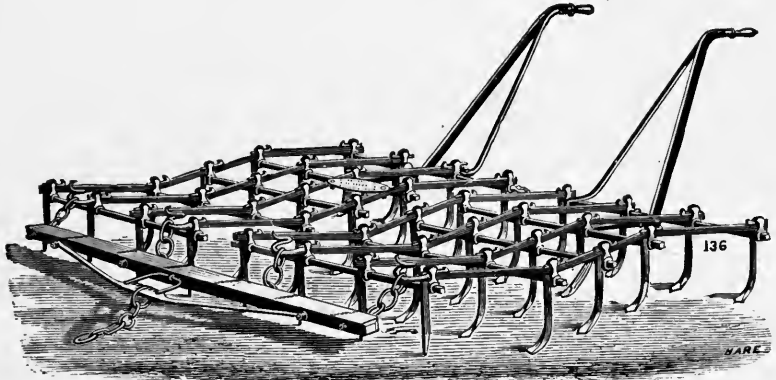


Fig. 268.—Nicholson's Handled Drag-Harrow.

The last of these names is not as common as the others, and, possibly, is peculiar to Sussex, or to that and other hop counties, as the old-fashioned implements used between rows of hops were called "hop-shims."

One of the most useful implements for working land to a tilth is the

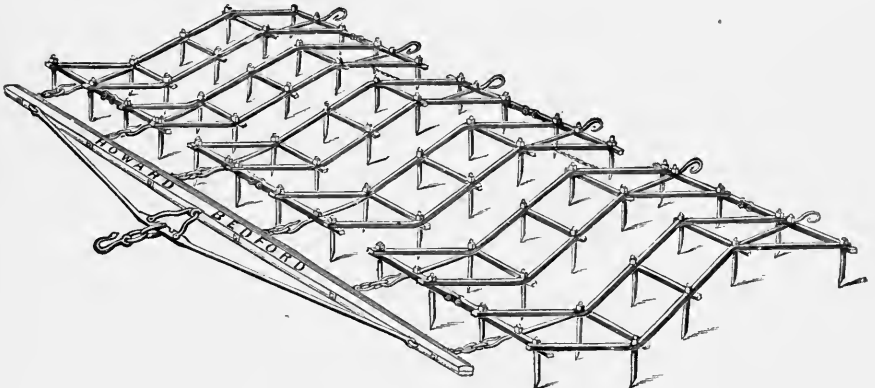


Fig. 269.—Howard's Iron Harrow.

curve-tined drag-harrow (fig. 268). The cultivator is very well adapted for breaking hard furrows, or for stirring tough land, but when this has been done the drag-harrow makes the most perfect work, for by the

shape and number of the tines the ground is stirred upwards so as to bring fresh earth to the surface, and at the same time lift out any couch or thistle-roots that may be in it. This implement is particularly useful in dragging out roots previously to laying down land to pasture. As in all other harrows, it is very necessary to keep the tines sharp, or the work cannot be effective.

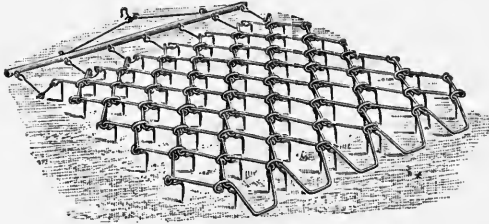


Fig. 270.—Parmiter's Flexible Harrow.

The *Harrow* (fig. 269) is an implement of essential importance in the management of farm-lands, not only for the purpose of covering the seed with earth, but likewise for pulverising the soil previously to its reception of the seed, and freeing it from the weeds and roots which it may contain. The improvement of the harrow has of late years become an object of considerable attention, and numerous alterations have been introduced in order to suit it to various soils and different modes of tillage. Iron harrows are now in most general use: they are made in

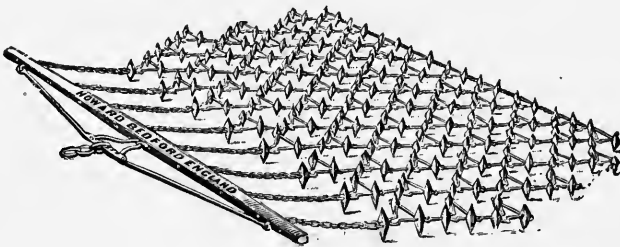


Fig. 271.—Howard's Flexible Grass Harrow.

sets of three or four, and light or heavy, according to the work for which they are intended, and are arranged to spread eight, ten, or twelve feet. Fig. 270 represents a flexible harrow, made by Messrs. P. J. Parmiter & Co., of Tisbury, Wilts, which has gained a good reputation for destroying charlock and other weeds; and this is found equally useful for harrowing pastures. The grass harrow is very essential to the grazier as well as to all farmers, and the one illustrated in fig. 271 is one of the best known. The points are made so as to work equally well on either side, by merely turning the harrow over. The work done is nearly perfect, dung being broken up and worked into



the land, or moss pulled out, equally well. Fig. 272 shows the disc harrow, which is very extensively used in the United States, but has not yet gained much hold in this country. Fig. 273 illustrates the form of ridge or saddle harrow for turnip or potato ridges.

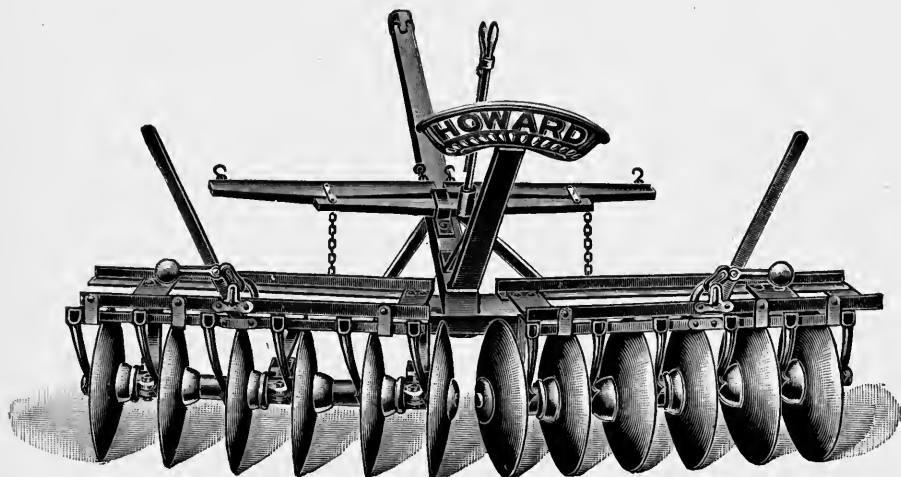


Fig. 272.—Howard's Improved Disc Harrow.

*Whippletrees.*—In some light land districts it is quite common to find no other whippetrees than those which can be worked by two horses abreast. When it is found necessary to attach three horses, either abreast, or two abreast and another as a fore-horse, there are no means of so adjusting them that each horse does its proper share of work—no

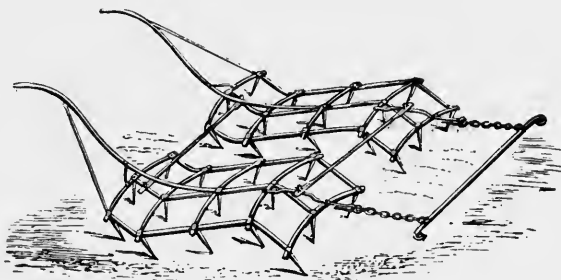


Fig. 273.—Ridge Harrow.

more and no less. Many different forms of whippetrees are made, however, which answer the purpose well, and in figs. 274, 275, 276, we show three useful types made by Messrs. Tasker & Sons, Andover, which can be employed for different numbers of horses without unduly working any of the animals.

*Rollers* are constructed now almost exclusively of cast iron; and of various sizes, according to the respective purposes for which they are

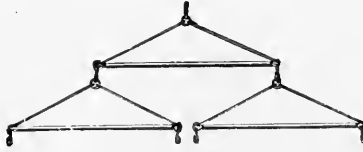


Fig. 274.—Whippetrees, for Two Horses Abreast.



Fig. 275.—Whippetrees, for Three Horses Abreast—in Tubular Iron.



Fig. 276.—Solid Iron Equalising Whippetrees.

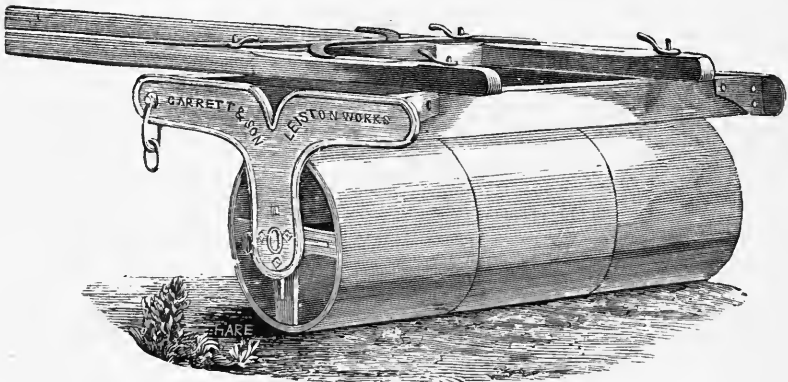


Fig. 277.—Iron Roller.

designed. The common rollers, generally used for pasture-lands, are from fifteen to thirty inches in diameter, and about six to eight feet in length.

The implement shown in fig. 277 is manufactured by Messrs. Garrett & Sons. The roller is in three parts, revolving separately on a spindle, in order to facilitate turning without injury to the crop. The

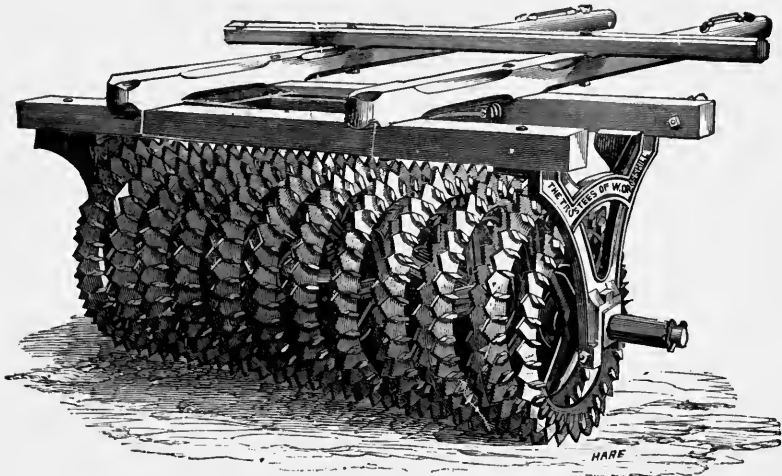


Fig. 278.—Clod Crusher.

frame is of cast iron. The shafts are singly joined together, so as to be easily attached to any part of the frame, in order that the shaft horse may walk in any required direction, each end of the roller having an

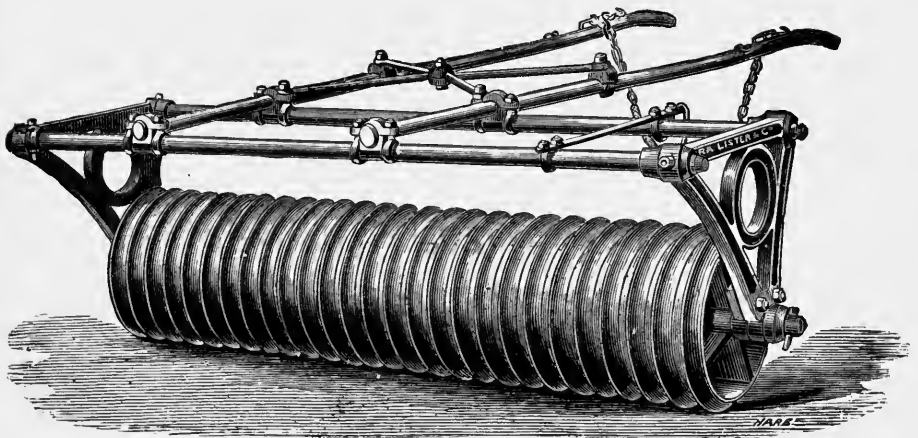


Fig. 279.—Lister's Balance Ring Roller.

attachment for a trace-horse. They are fitted with swing scrapers, which, by means of weights, adjust themselves to the cylinders as required, and prevent the soil from sticking to or clogging the roller.

Unless the diameter of a roller is fairly large it does not turn easily, and is liable to drive clods before it. There is much to be said in favour of the hollow rollers which can be filled with water when weight is required, and used empty for light work. These are made by Messrs.

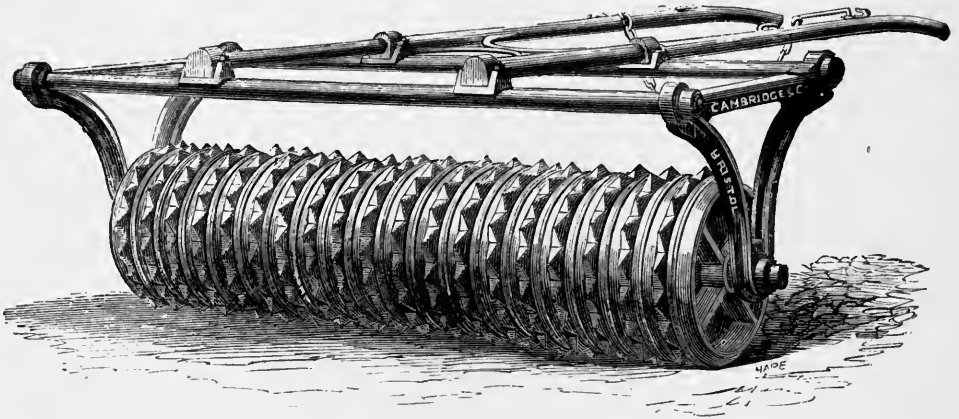


Fig. 280.—Cambridge Roller.

Barford & Perkins, of Peterborough, and probably by some other manufacturers.

We present, in fig. 278, an engraving of another implement useful to the farmer, the Beverley Iron and Waggon Company's Clod Crusher. It is most valuable in crushing clods on heavy lands, and, when other machines are useless, in dry weather.

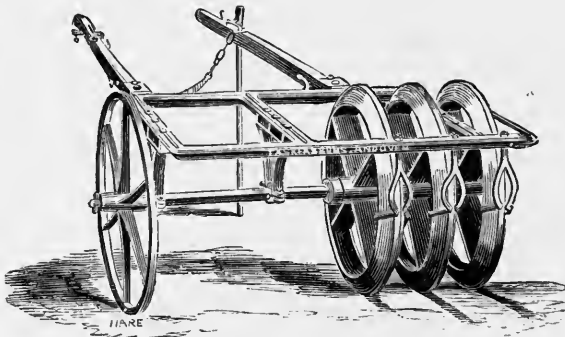


Fig. 281.—Tasker's Land Presser.

The ring-roller, of which fig. 279 is an illustration, is useful for rolling wheat in the spring. It may also be employed in the case of other crops beneath which the soil is too loose, or which are affected by wire-worm or other insects which attack the plant when young. It is likewise applicable as a clod crusher.

In fig. 280 we illustrate a very celebrated form of roller known as the "Cambridge Roller" from its inventor, Mr. Cambridge, of the firm of Messrs. Cambridge, Parham, & Webb, of Bristol. It answers the purpose of a clod crusher, or land tightener, admirably.

An essential implement on light soils is the furrow-presser (fig. 281). On thin, chalk soils it is a necessity, for it would be difficult to grow certain crops without it. There is no doubt, moreover, that many other soils would derive great advantage were the presser used on them.

The *Horse-hoe*. Horse-hoes are such important labour-saving imple-

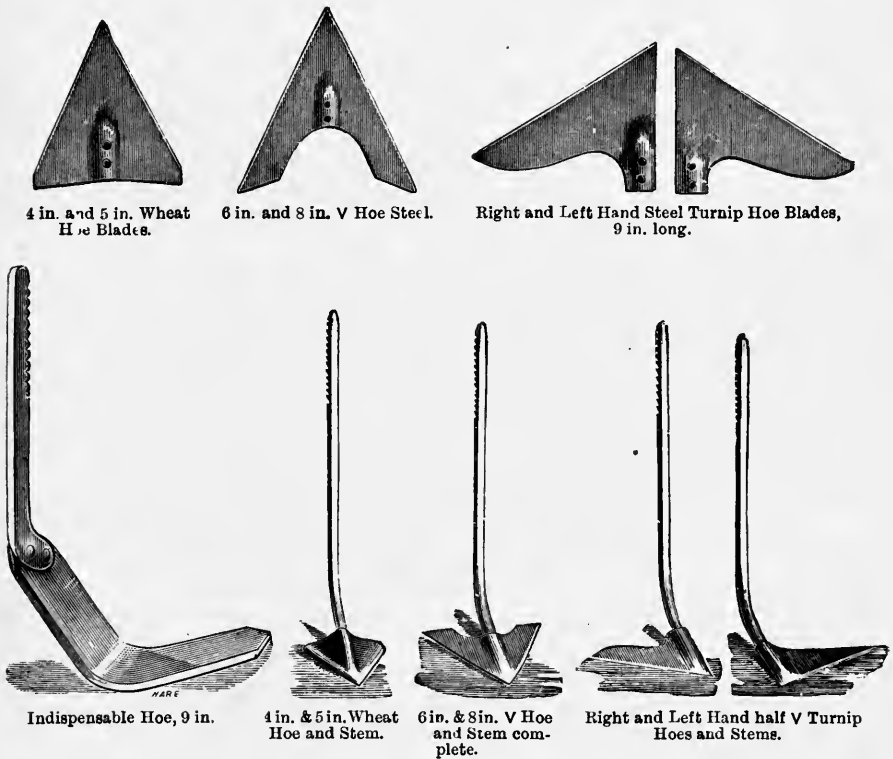


Fig. 282.—Forms of Hoes to work on the Lever Horse-Hoe.

ments that they are worthy of detailed notice. For horse-hoeing to be well done it is necessary that the corn or roots should be drilled with great accuracy, and it is partly to the bad work done by drill-men that the opposition to horse-hoeing is due. That horse-hoes are in disfavour with some careful farmers cannot be denied, but if drills are used with good steerage attachments, and the drill-men and hoe-men are capable, there can be no doubt that they are among the most useful and efficient implements on the farm.

Messrs. W. Ball & Son's horse-hoe represents a familiar type, and it is well adapted for working in roots which have just come up. The hoes on the back bar are called "Indispensable" (see an illustration in fig. 282), and are very useful when the plant is in this early stage, but as they do not face hard ground so well we prefer V-shaped hoes in

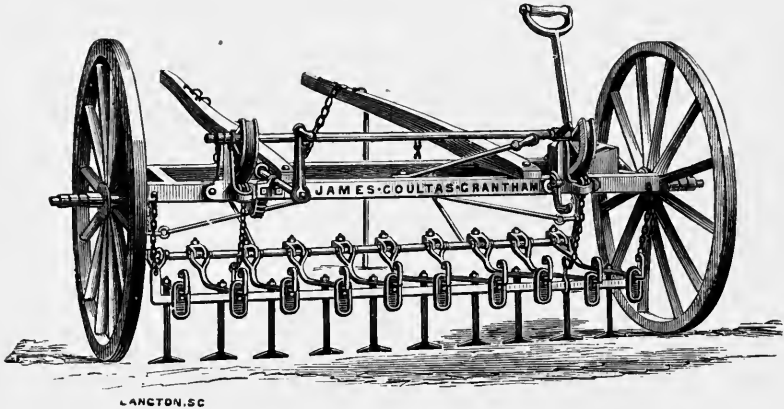


Fig. 283.—Coultas's Horse-Hoe.

subsequent workings. It is our practice to use at first only one large hoe in a row; this covers all the space between the rows of plants, and as the stem is in the middle there is no risk of the young plants being smothered. In our opinion a great mistake is made by using L-shaped

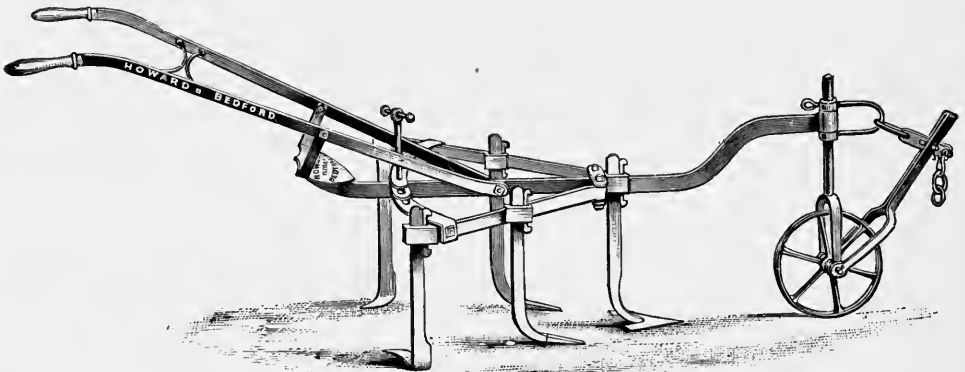


Fig. 284.—Howard's Expanding Single Row Horse-Hoe.

hoes at any time, for they cannot be forced into hard ground so readily, and the mistake is greater when the flange is turned inwards so that the stem runs next to the row, for then there is great risk of smothering the young plant. The practice of working the flange inwards has arisen because it is feared that unless the widest cut of the hoe is seen, as it is

not when underground, the plant is in greater danger of being destroyed; this, however, is an erroneous idea, for if the holder exercises ordinary care he intuitively steers the implement with accuracy and safety. The L-shaped hoe is always a mistake, and if a single-flange hoe is desired it should be in the form of a half V, which does not cause the soil to drive so much, and is easier for the man to hold and for the horse to pull. The stems are sometimes made with chisel-points to which flanges may be fitted; or the flanges are welded on, and relaid as required. The illustrations in fig. 282 show several good forms of hoes.

As we have said, we are strongly in favour of the use of one large hoe to cover the space between two rows of turnips, and such hoes will be found very useful for cutting thistles in tilths, where it is not desired to plough the land again. Horse-hoes are too often only employed to destroy weeds, but they should also be used with the object of deep-tilling between the roots, for this promotes the growth of rootlets.

Mr. James Coultas, of Grantham, has brought out a very simple and useful lever horse-hoe, illustrated in fig. 283. It is suited to crops drilled on the level or on the ridge, the wheels being movable at both ends to suit the varied intervals between rows of plants. As shown, it is set for a corn crop; but for roots Goss & Savage's special shares and shanks are supplied. The hoeing of white-straw crops, either by horse-machines or by hand, is much less common than it was at one time; but peas and beans are almost invariably hoed, and usually by horse-power. On heavy soils wheat has often been injured by horse-hoeing, especially after a wet winter when the soil has been run into a compact mass. Under such circumstances the action of a horse-hoe is apt to lift the soil in great pieces, loosening the roots of the crop. This objection does not apply to free-working soils. Crops on the ridge are best hoed one row at a time. The hoe in fig. 284 is a very good type of a single row hoe, and any form of hoe can be attached to the frame. Some are made with a strong body in front, to which is attached a grubber-point, and these are particularly useful, when the land is excessively hard, for breaking a way for the hinder hoes.

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## CHAPTER V.

### SOWING MACHINES AND MANURE DISTRIBUTORS.

IT is essential that corn- and seed-drills should be accurate in placing the seed, as corn germinates unevenly when deposited at different depths. It is obvious, too, that regularity in the depositing of the seed is of great importance, while lightness of draught is also of considerable importance. The attainment of these objects largely depends upon the form of the coulter and the arrangement for conveying the seed. Until a comparatively recent date the only drills used in this country were

those with cutting coulters and cup feed. A few years ago, however, drills with what is known as "force" feed and with four shapes of

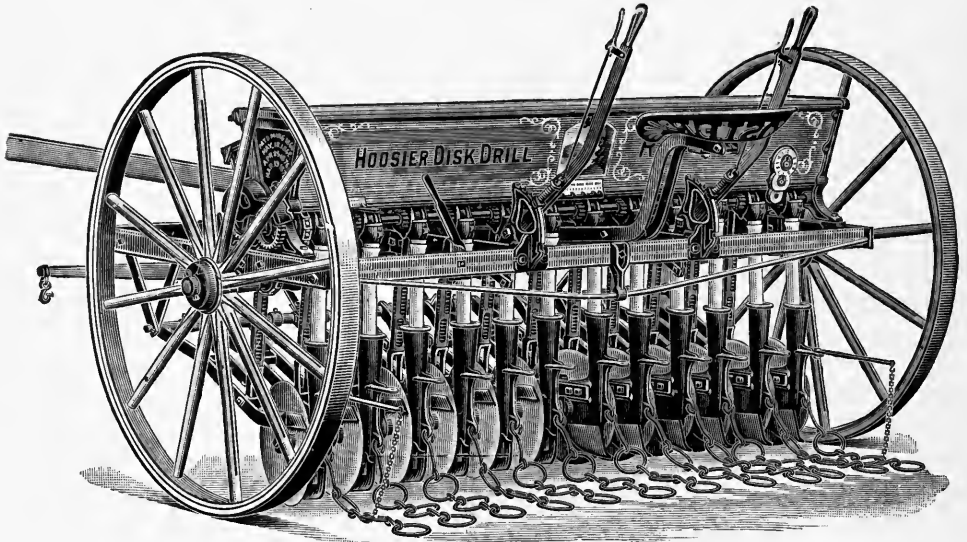


Fig. 285.—The Hoosier Single-Disc Drill.

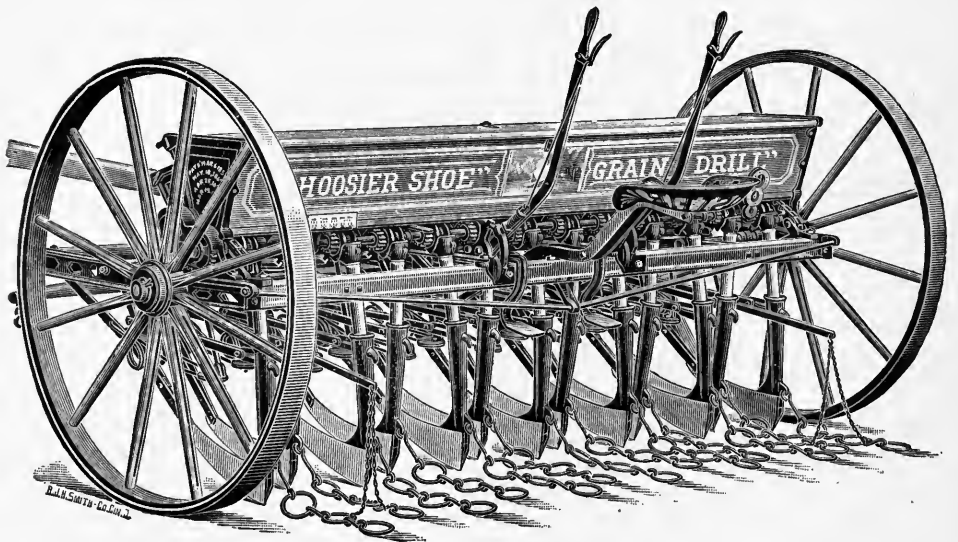


Fig. 286.—The Hoosier Shoe Drill.

coulters were introduced from the United States. These coulters are respectively the single-disc, the double-disc, the hoe, and the shoe. Mr.



Primrose McConnell, who has made a careful study of drills and has worked those of many types personally, declares the force feed to be greatly superior to the cup feed, while he places the single-disk coulters

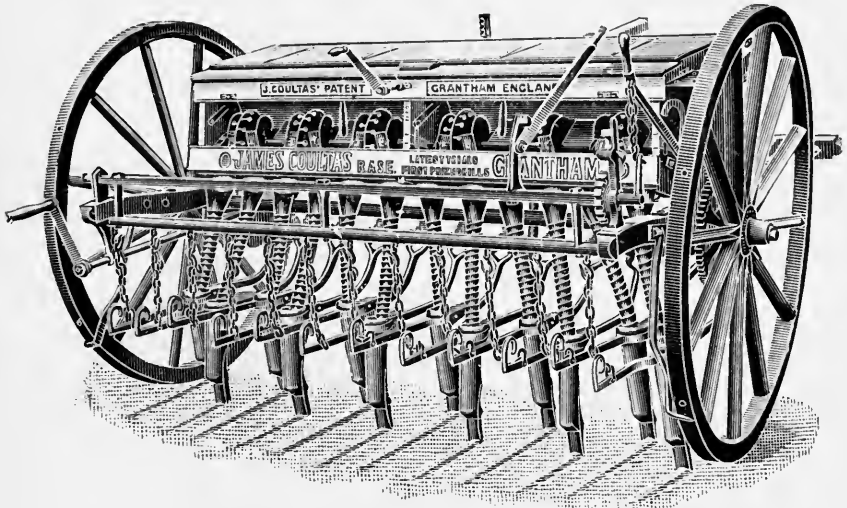


Fig. 287.—Coultas's Corn and Seed Drill.

first, the double-disk second, and the shoe third, entirely condemning the hoe and the cutting coulters. In figs. 285 and 286 we show the Hoosier (American) single-disk and shoe drills, supplied in this country

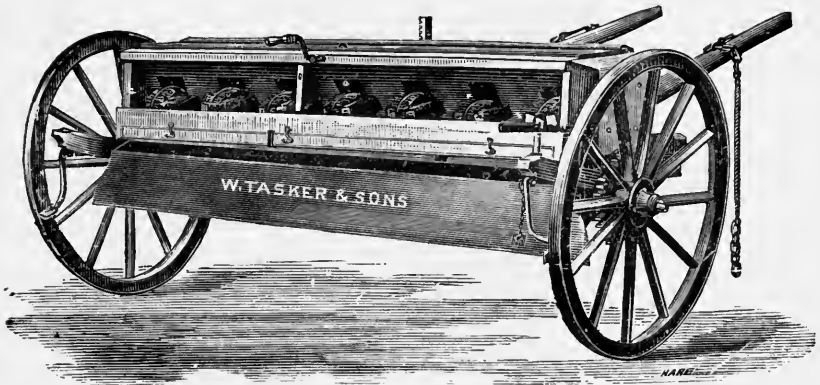


Fig. 288.—Tasker & Sons' Corn Broad-Caster.

by Messrs. Wallace & Sons, of Glasgow. These are the best of their types known to us. Both have force feed. A serious fault in American drills is that they have fixed coulters bars, which prevent the proper adjustment of the width between the rows of seed, although, of course,

coulters can be taken out. Some English makers supply disc coulters, but usually with cup feed. Mr. Coultas, of Grantham, has a single-disc drill with cup feed. Messrs. Hornsby & Sons, of Grantham, however, make a disc drill named the "Hornsby Hoosier," with force feed, and this, we believe, has movable coultter bars.

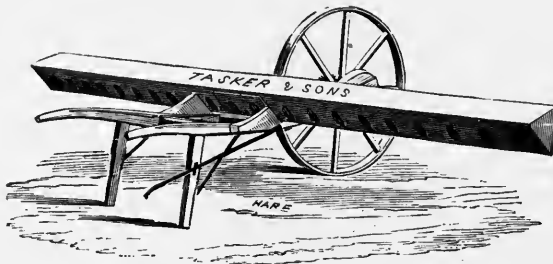


Fig. 289.—Tasker & Sons' Broad-Cast Grass Seed Distributor.

Fig. 287 illustrates Mr. Coultas's drill fitted with V-shaped and reversible coulters as improvements upon the ordinary form of cutting coulters. When it is intended to horse-hoe corn grown with narrow spaces between the rows, as is the case with wheat, barley, or oats, a fore-

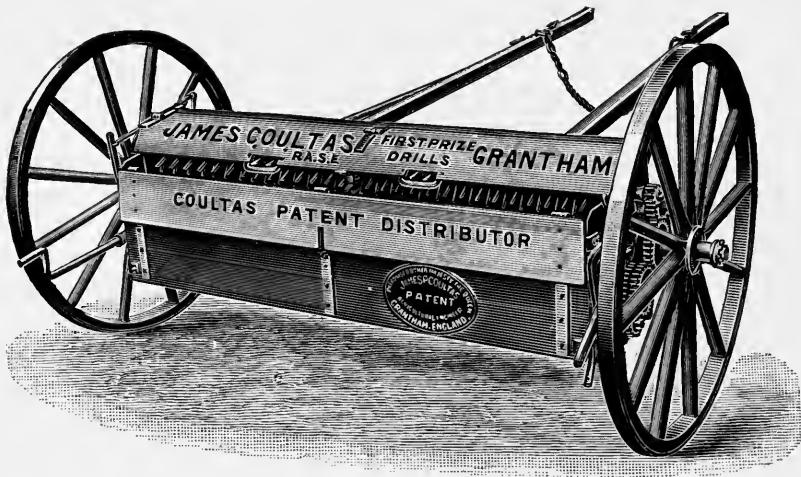


Fig. 290.—Coultas's Manure Distributor.

steerage, which can be fitted to an ordinary drill, and is sent out, if desired, with Mr. Coultas's implement, should be used, as the rows can be kept straighter by this means than when no fore-steerage is used.

The old custom of sowing corn broadcast is not practised so much as before the introduction of coultter drills, and good "seedsmen" are less

frequently met with. On some soils broadcasting is still, however, very much in favour, and it is far better to use a good distributor like the one in fig. 288 than to run the risk of spoiling the crop by uneven seeding. These implements are simple in construction and very durable.

Seed-barrowes with brushes instead of cups are preferable for sowing

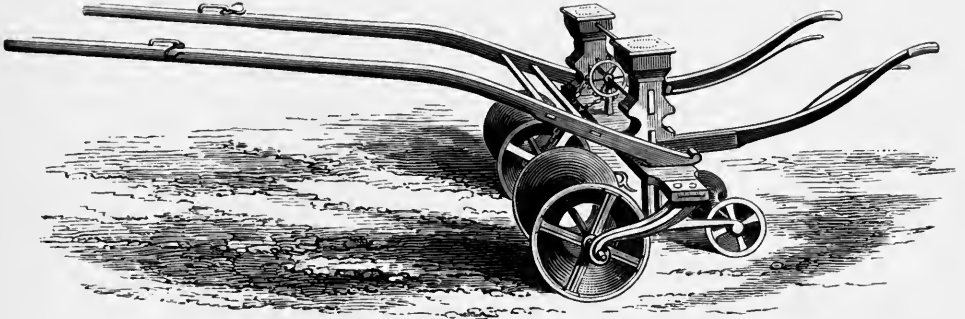


Fig. 291.—Horse Power Turnip Sowing Machine.

small seeds such as clover, grass, or mustard, and the one shown in fig. 289 is a strong and useful implement.

The use of superphosphate and other concentrated manures for root-

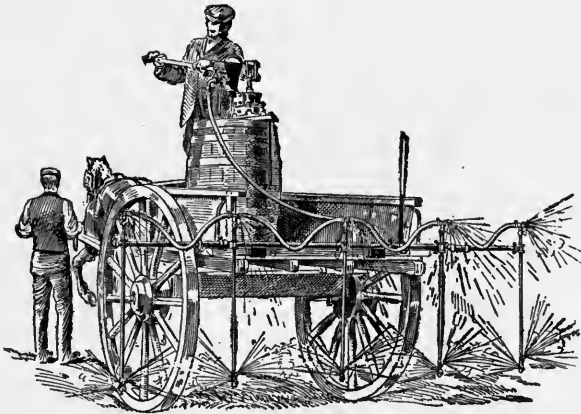


Fig. 292.—Strawson's Potato Sprayer attached to Farm Cart.

crops has made the manure-drill a necessity, and fig. 290 shows a good one.

Bouting drills are used where the roots are sown on the ridge, which is commonly the case on heavy land, or in wet districts. Such drills are generally made to drill more than one row at once, the more usual number being three or four. The ridging or bouting-drill (fig. 291) is,

as a rule, made with rollers to consolidate and shape the ridges before the seed is drilled, and small rollers follow to cover it in afterwards. Small single-row drills of this and many other types are also made by different firms.

No machine has excited more interest during the last few years than

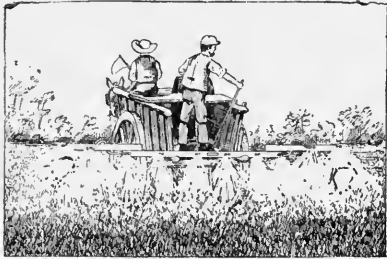


Fig. 292a.—The Strawsonizer Spraying Charlock.

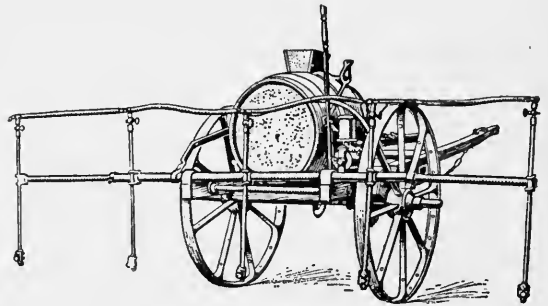


Fig. 293.—The Mikado Spraying Machine.

the Strawsonizer (fig. 292) invented by Mr. G. F. Strawson, 71A Queen Victoria Street, London, E.C., but now manufactured by Mackies, Ltd., of Reading. It was brought out by the inventor mainly for the purpose of sprinkling or spraying powders or liquids upon plants infested with



Fig. 294.—Tasker's Water and Liquid-Manure Cart.

insect or fungus pests. The necessity had long been recognised of producing a machine which could be used to distribute insect-destroying powders or liquids rapidly, finely, and effectively, and the Strawsonizer fulfils these objects satisfactorily. The illustration (fig. 292) shows the machine as attached to a farm cart and arranged for the spraying of

potatoes for the prevention or checking of the common disease of that crop. Fig. 292a illustrates the same machine adapted to the spraying of charlock in corn crops, and fig. 293 displays the sprayer as arranged for potatoes, independent of a cart, in which form it will get over a large acreage in a day, as it is an automatic machine, whereas the apparatus attached to a cart requires one man to work the pump. Another advantage of the Mikado is that the wheels can be shifted to suit the rows of potatoes. It is made for five or seven rows, and the larger machine can be made to spray 30 acres in a day. The cart machine, of course, is much cheaper than the Mikado, and for farms of small or medium size it does the work quite quickly enough. Other forms of the Strawsonizer are fitted for distributing powder. Messrs. Mackies also construct machines for spraying fruit, hops, vines, flowers, tea, coffee, and other crops. Some are large enough to require a horse or pony to draw them, while others are in knapsack form.

Liquid-manure carts must be looked upon as manure distributors, and they are very essential where animals lie on slatted floors, or wherever there is a liquid-manure tank. Fig. 294 illustrates a liquid-manure cart fitted with a pump: by taking off the distributor it becomes a convenient water-cart, such as is necessary on all farms. Iron carts are preferable to wooden ones because the former can be more easily cleaned, and freed from unpleasant odours.

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## CHAPTER VI.

### STEAM AND OIL MOTOR CULTIVATION.

**H**AVING described the more important implements worked by horses in tillage operations, we will now consider those worked by steam. Steam as a motive power for working field implements has been used for a great number of years, but it was not until less than half a century ago that it became at all common. It, perhaps, first made its advantages generally felt at the time when farmers and their men were brought into antagonism—about the year 1870, for as manual labour was short, and horses were scarce, owing to the demand for them because of the great prosperity which attended all English industries after the Franco-Prussian War, it was found difficult to work the land thoroughly. Later on in the seventies a series of wet years set in, and so much difficulty was experienced in keeping the work forward, that the aid of steam was called in to do it. It then seemed as though steam would take such a prominent position that horses would have but little to do. The work, however, was often done injudiciously, the same care which good tillers had bestowed on their horse tillages not being exercised, so that the reputation of steam suffered, with the result that instead of

ousting the horse, it is now chiefly used as an auxiliary. In this way it renders most valuable assistance, for it can be utilised to move large tracts of land in a very short time. Thus, when a few favourable days come early in the year for working the land, much of it can be got into a forward condition; horses can be put to the lighter operations, and the crops can be sown in their proper seasons, which in wet years and with the ordinary team of horses kept on the farm is often impossible. Immense advantage is gained in the summer in working bastard fallows, whilst after harvest a very large amount of autumn cultivation can be done, which materially lightens the work in spring, and throws the work of the whole year forward. If there is one thing which, more than another, tends towards successful farming, it is being well up with the work at all seasons: the man who is well in front of his work on the land is rarely an unsuccessful farmer.

The advantages and disadvantages of steam cultivation are now pretty well known. If horses and steam both had to be hired there might be individual cases where it might be found more economical to use steam, so far as it can be applied to the classes of operations done by horses. Therefore, while this would be the case in the circumstances mentioned, we would not recommend farmers to buy a set of steam tackle for exclusive use on their own farms, unless these are very large. The outlay is too great, for it is additional to that which it is necessary to expend on the horse team to do other work on the farm, such as carting. Of course, the engines may be used for threshing the corn, and, as will be seen later on, to do most of the tilling and weeding operations; but the horses necessary for the work which must be done by them at particular times of the year are, as a rule, sufficient for the additional work at other seasons, with very little help. Moreover, as horses cannot be bought and sold just as they are wanted or not, they must be kept throughout the year. These remarks do not apply so much to large estates, and it is on these that steam is a most valuable aid, for when the engines are not at work on the land there is generally something for them to do elsewhere. It pays then to keep a first-rate man to attend to the machinery, though this is not always thought to be necessary on a farm, because he has little to do during the greater part of the year, and is looked upon as being too expensive. An incompetent man is set to look after the engine and the machinery, which soon get out of order and rapidly deteriorate in value. Expensive machinery requires to be in good hands, and those are the most successful with it who can do the greater part of the repairs themselves. As farmers are rarely able to do this, it is better that they should hire from those who can.

Among the errors in the working of the land which have done much to impair the reputation of steam, we may mention a few. Some of these might have been guarded against, and certainly should be in the future. It was strongly urged by men of high standing at the time when steam was gaining repute in the "seventies," that high-backed lands on the stiffer soils should be levelled and drained, and worked by

steam. They found many disciples at the time, and a considerable breadth of land was treated in this way. Unfortunately for them the weather was not favourable, and the great rainfall at the end of the seventies plainly showed that they had made a mistake, as the water would follow its old course, with the result that it did not get to the drains. Hence it was found impossible to follow up the system. A large amount of land was rendered unworkable, and it was not until it was laid up in stretches, as before, that it would pay for working. Steam is at a great disadvantage in working heavy land that requires to be so treated. It is much better suited to light and medium soils; but on all classes of land it is important to avoid one error which has done much to bring steam cultivation into bad repute, namely, that of bringing comparatively sterile subsoil to the surface.

Another great mistake is to use the steam cultivator too late in the autumn. Immediately after harvest it is an excellent implement to employ, but when the autumn rains set in the cultivator should be out of the field. It is safe to use the steam-plough much later in the autumn than the steam cultivator, because the plough leaves the land in furrows which assist the water to drain off, whereas, when it is merely thrown up by the cultivator, it lies so that it holds the moisture, and is waterlogged throughout winter; consequently it is harder to work and get into proper condition for seeding in the spring. Much damage is done by the heavy tackle moving about the fields in wet weather, and many extensive systems of drainage have been rendered futile owing to the mains along the headlands being crushed in by the engines.

There are three systems of steam cultivation which have come into common use. The first to obtain favour was the single-engine roundabout system, which is worked by a windlass and self-moving anchors travelling on two opposite headlands of the field, while the engine remains stationary. Two advantages of this system are the comparatively small cost of the tackle and the comparative lightness of the engine required to work it. But still it has been almost entirely superseded by the second system to be mentioned, the double-engine system, which is by far the most effectual in economy of power and speed of working. Intermediate is the double-drum system, worked by one traction engine with two winding drums travelling on one headland and a self-moving anchor travelling on the opposite headland. With the double-engine system there is a direct pull on the implement between the two engines, without loss of power from the interference of pulleys and snatchblocks, while there is economy in the small length of wire rope and in the employment of a minimum amount of horse and manual labour, as the traction engines carry all their requirements with them from field to field, and from farm to farm.

The necessity of economising space renders it obligatory to confine our illustrations to one of the engines and the implements used in the prevailing system. We can notice only in passing a fourth system of steam cultivation which has not been named among those which have been hitherto in common use. For some years past ponderous steam diggers have been used to a limited extent. The first was introduced by Mr. Darby,

of Chelmsford, and another, many years later, by the Cooper Steam Digger Company, of King's Lynn. Both have made excellent work when the land

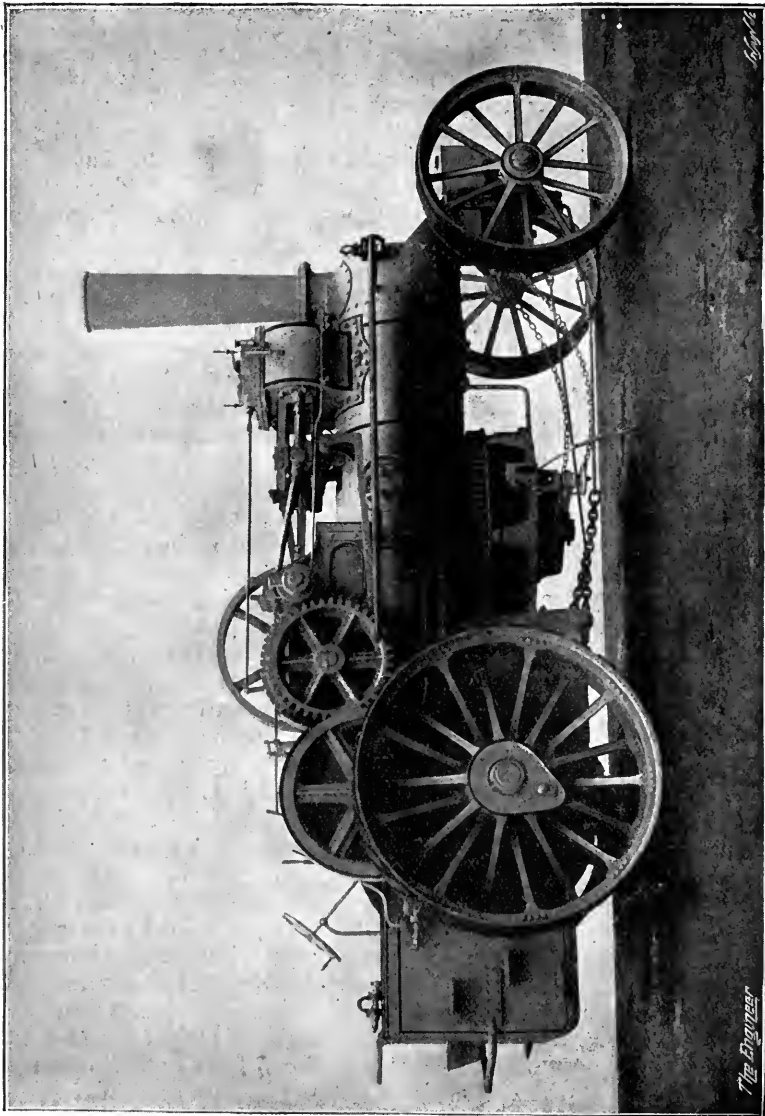


Fig. 295.—Fowler's Compound Steam Ploughing Engine.

was dry; but their enormous weight must render their use objectionable at other times. They may be briefly described as traction engines which



travel over the fields, cultivating the land as they travel by means of sets of prongs or other digging agencies in their rear. A trial of the two was held by the Royal Agricultural Society at York in 1900, and it is fully described in the *Society's Journal*, Part III., 1900.



Fig. 296.—Fowler's Patent Anti-balance Plough.

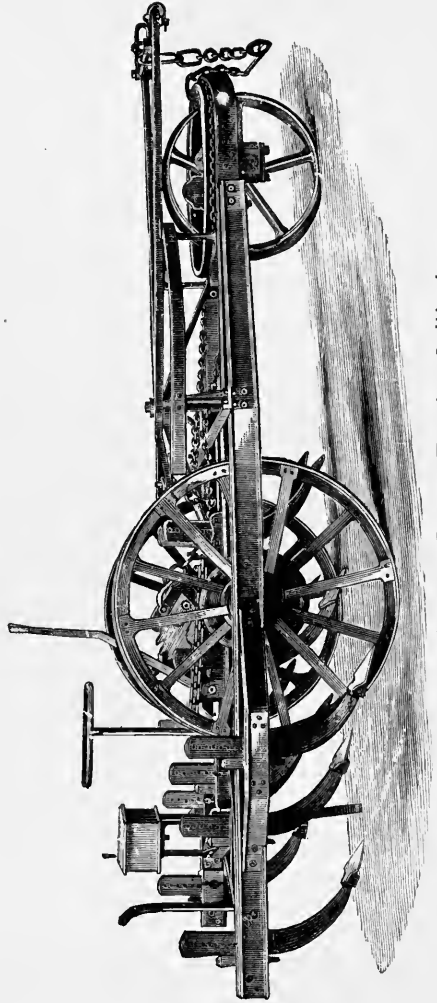


Fig. 297.—Fowler's Patent Turning Cultivator.

To revert to the double-engine system, which has been greatly improved in recent years, we show in fig. 295 one of the newest engines of Messrs. John Fowler & Co., of Leeds, with compound cylinders which

economise the water and fuel to the extent of at least 30 per cent. as compared with single-cylinder engines. This is very important, for, in many districts, the carting of the fuel and water is, in addition to the actual cost of the former, a very serious item in the expense of working land by steam power.

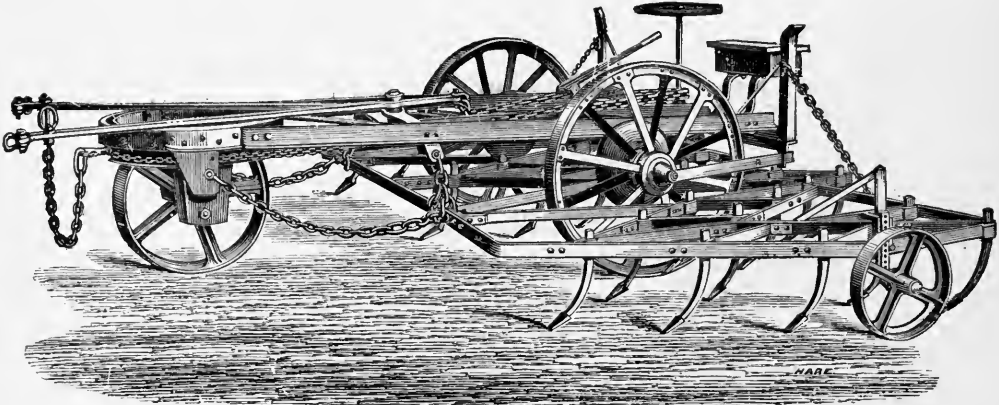


Fig. 298.—Fowler's Patent Turning Harrow.

As an improvement upon the balance plough, Messrs. Fowler have introduced what they call the anti-balance implement (fig. 296), the advantages of which we lack space to describe. It can be made with three to eight

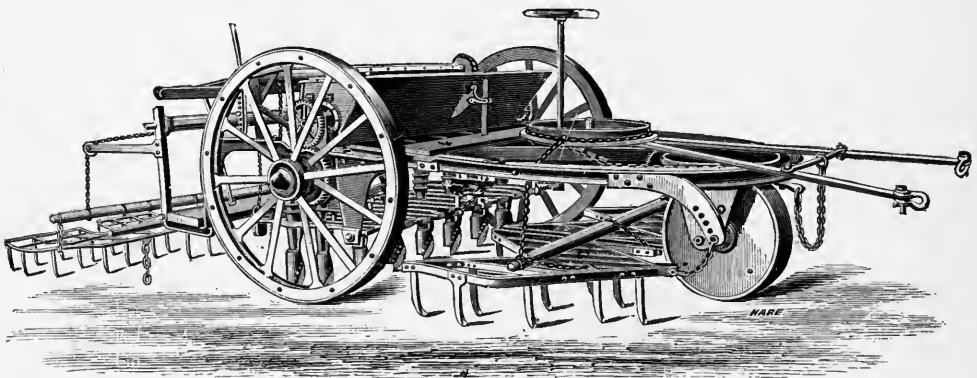


Fig. 299.—Fowler's Steam Drill.

mould-boards at each end, and these can be fitted with digging-breasts if desired. An anti-balance disc plough is also made.

The most useful implement connected with steam tillage is the cultivator, represented in fig. 297. It is extremely well adapted to breaking up land without inverting it, so that the couch is kept near the surface, and with a reasonable amount of stirring can be killed.

Whenever practicable, especially on heavy land, it is better to plough once during the course of tilling, so that a level bottom may be formed; if this is not done the ploughing is rendered much more difficult when breaking up the land again after it has been cropped.

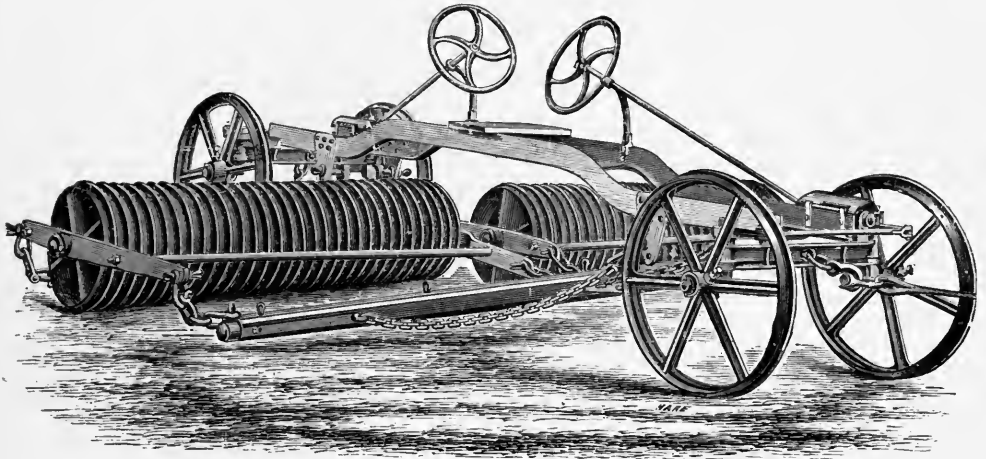


Fig. 300.—Fowler's Steam Roller.

The steam harrow, such as the one shown in fig. 298, is usefully employed for stirring and cleaning land which has been previously broken up. It will take a breadth of from 10 feet to 15 feet, according to the size of the set, and can therefore be made to stir as much as 50 acres in a day. This is often a great advantage, as it takes the heaviest and slowest work off the horses, and a few good days in a wet season may be turned to the best account. If used on fine tilths it is liable to bury the couch when run very fast, so care should be taken in this respect; otherwise it is a first-rate implement.



Fig. 301.—The Ivel Motor Hauling a Three-Furrow Plough.

The combined implement shown in fig. 299 is a drill with heavy harrows in front, and light seed-harrows behind to cover in the seed. From 20 to 40 acres can be sown in one day with this machine, as it can be driven at high speed.

With fig. 300, Fowler's steam roller, we conclude our illustrations of the more common implements necessary to work land under ordinary circumstances. Among other implements are the draining and reclamation ploughs.

A recent introduction is the oil motor travelling over the land and



Fig. 301a.—Marshall's Motor Drawing Cultivator.

working a plough, cultivator, or other implement, and used likewise for drawing sheaf-binding reaping machines, as a traction engine on roads, and for threshing, grinding, chaff-cutting, and other operations. The first adaptation of the oil motor to land cultivation to come into public



Fig. 301b.—Saunderson's Motor Drawing Two Binders.

notice was that of the late Mr. Dan Allbone, his invention being named the Ivel Agricultural Motor. As drawing a three-furrow plough, it is shown in fig. 301. It is now manufactured by the Ivel Agricultural Motors, Ltd., Great Marlborough Street, London, W. As illustrated, it weighs only 32 cwt., a weight which makes comparatively little impression on the land in dry weather. With the aid

of acetylene lamps, it can be worked by night in cases of emergency. It has been used also for cultivators, harrows, a couple of binders or mowers at one time, threshing, road traction, and other operations of the farm.

A great number of prizes have been awarded to it after trials in different parts of Great Britain and other countries. The makers state that in trials they have found that about 6 acres of medium soil can be ploughed by the motor 7 inches deep in nine hours, at a cost for fuel, lubrication, labour, wear and tear, and renewals of less than 5s. per acre.

A more recent introduction is the Marshall oil motor, illustrated in fig. 301a, and manufactured by Messrs. Marshall, Sons, & Co., of Gainsborough. This motor has created a very favourable impression in public trials and private use, and has already been awarded prizes in this and other countries. It is made in different sizes, and one of thirty actual horse power weighs about  $4\frac{1}{4}$  tons. The makers state that a motor of this size will draw a four-furrow plough in stiff clay, cutting 7 in. to 8 in. deep and 10 in. wide, and getting over  $6\frac{1}{4}$  acres in ten hours, or cultivating 12 to 20 acres in ten hours, according to the character of the soil; or it will haul a load of 10 tons on a good road at a speed of 6 miles per hour, or drive a 4 ft. 6 in. threshing machine, with chaff-cutter and blower.

A third introduction of like character is the "Universal" motor, invented by Messrs. H. P. Saunderson & Co., of Bedford, illustrated in fig. 301b as drawing two sheaf-binding reaping machines. This motor, like those named above, is applicable to ploughing, cultivating, and various other farm purposes, and road traction. It also has been awarded many prizes.

It is impracticable to enter into the special advantages claimed for each of these inventions; but each has particular merits, and only prolonged competitive trials in various kinds of work could prove which is the best on the whole. Whether oil motors for land cultivation and general farm work will come into common use, only time can determine. It is obvious, however, that for many odd jobs which at present can be done only by horses, these comparatively light and handy motors can be used when there would be no thought of using ponderous steam engines.

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## CHAPTER VII.

### REAPING AND MOWING MACHINES—HAY-MAKING MACHINES—CARTS AND WAGGONS.

*REAPING MACHINES.*—About the beginning of the last century the first attempt was made to employ machinery for the purpose of reaping corn; but it was not till 1851, the year of the first "Great Exhibition,"—at which a machine, the design and make of McCormick, of the United States, was exhibited,—that a real practical interest was taken in this department of agricultural machinery. Since then there has been an uninterrupted flow, so to say, of new inventions and im-

provements, and though it has often been said that these had reached perfection, yet the application of better mechanical principles, the introduction of steel in places where it was not used formerly, and the lessons taught in the past, continue to bear fruit, and since the twelfth edition of "The Complete Grazier" was published, "binders" have come into general use. We place before the reader a few illustrations of machines of good repute, but it is impossible to give all those of the many makers whose implements well deserve the high esteem in which they are held.

The first reaping machine to come into at all common use in this country was a ponderous, but effective one brought out by Messrs. Crosshill, of Beverley. It was driven in front of three horses walking abreast, and one of its great advantages was that it could cut its own way into a field of corn without any trampling upon what was uncut.

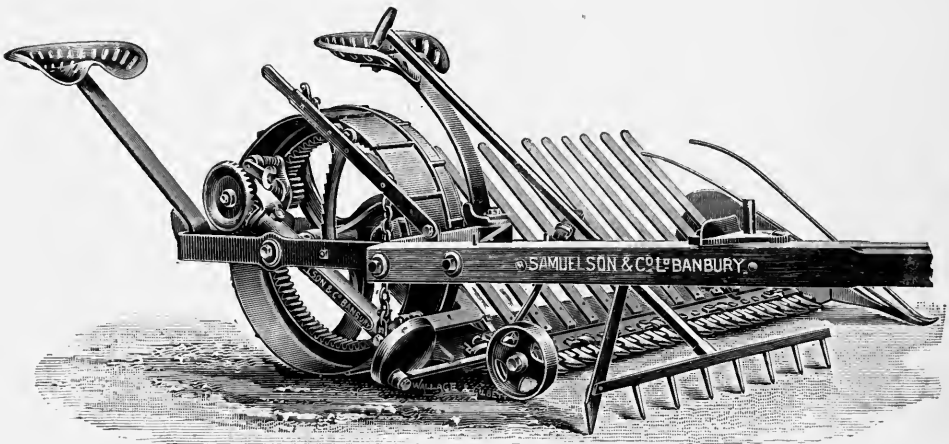


Fig. 302.—Samuelson's Manual-Delivery Reaper

It was introduced about 1860, or a little earlier, and was in somewhat common use in some parts of the country in 1862.

The next machine to come into common use was a one-horse manual back-delivery reaper, named the "Simplex," introduced by Messrs. Samuelson & Co., of Banbury, in 1863. Similar reapers were soon made by other firms, and machines of this type are still used on some small farms. One of them is illustrated in fig. 302. A modification in the form of a self-acting back-delivery reaper is shown in fig. 303. The only reasons for using a back-delivery reaper that can be considered valid are its comparatively low price and its need of only one horse to work it, as the inconvenience of having to tie up the sheaves behind the implement, before its track for a fresh cut is ready, is obvious. If a part is broken or a bolt drops out, all the hands engaged in tying are at a standstill. The work of the man who sweeps the cut corn off the

manual-delivery reaper is heavy, and although the self-acting back-delivery machine saves this work, it requires two horses to work it.

The self-rakers of the type illustrated in fig. 304 were introduced

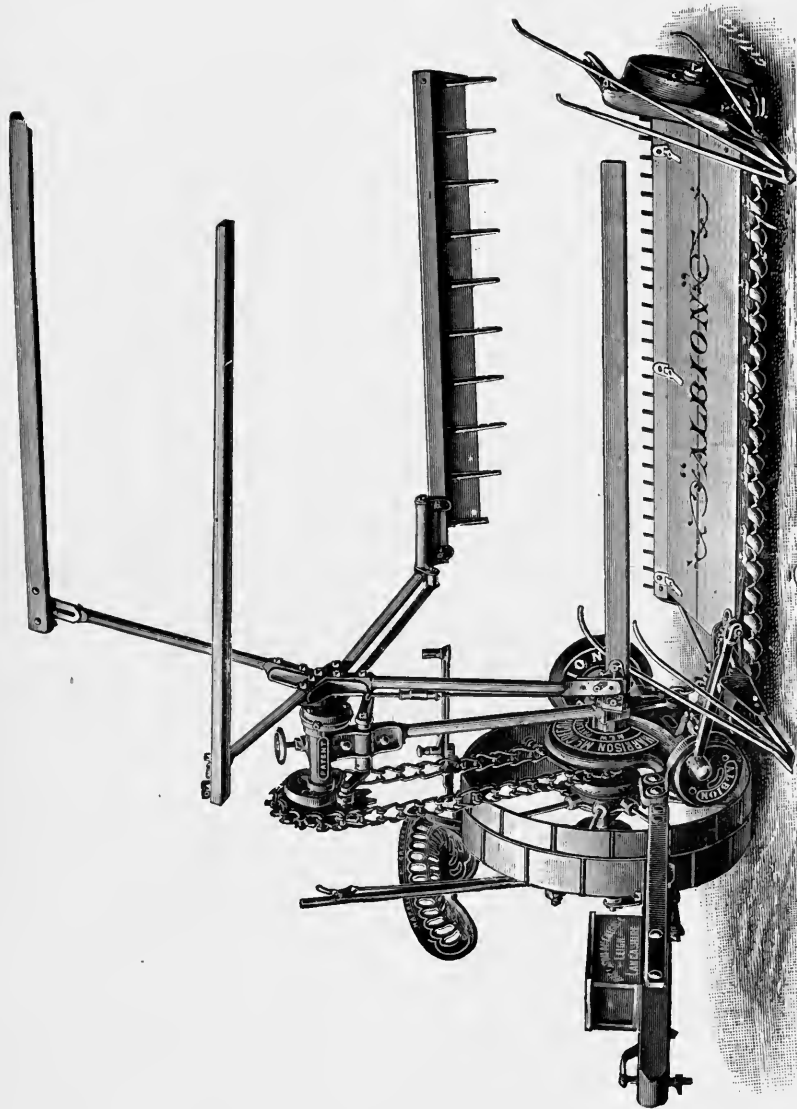


Fig. 303.—Harrison, McGregor & Co.'s Self-Acting Back-Delivery Reaper.

shortly after the manual-delivery machines appeared. They deliver the cut corn in bundles ready for binding on one side of their track, so that a whole field may be cut ahead of the binders. Therefore, they

were welcomed as great improvements, and speedily came into extensive use. As labour-saving machines, however, they left much to be desired. The final development of reaping machinery up to the present time

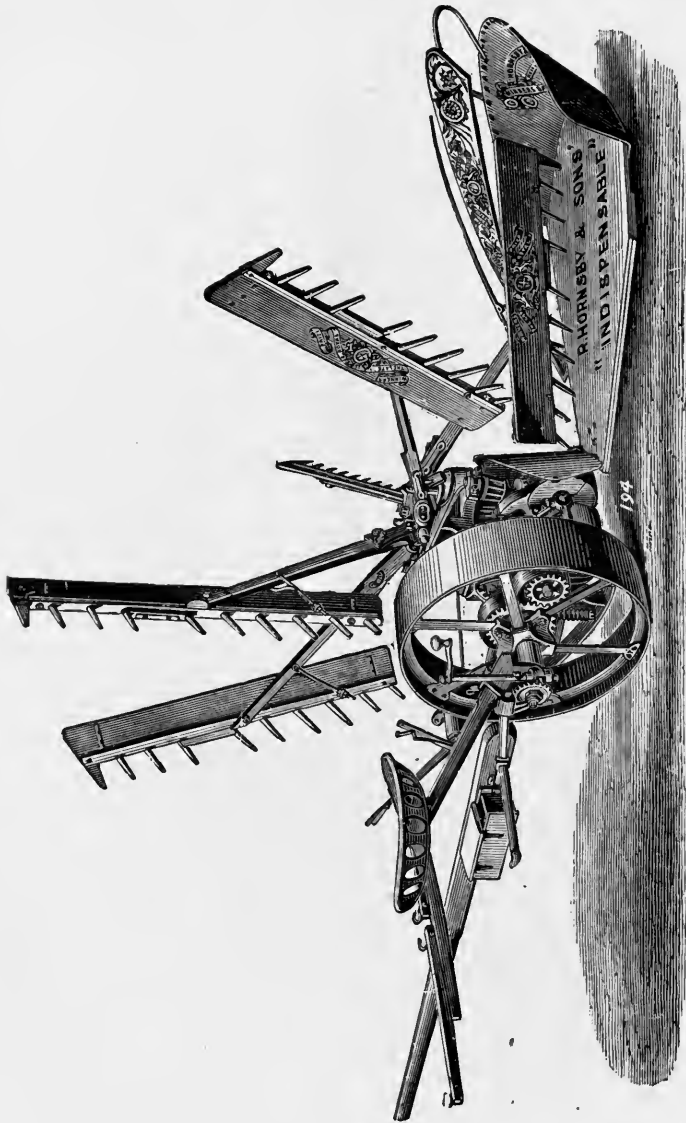
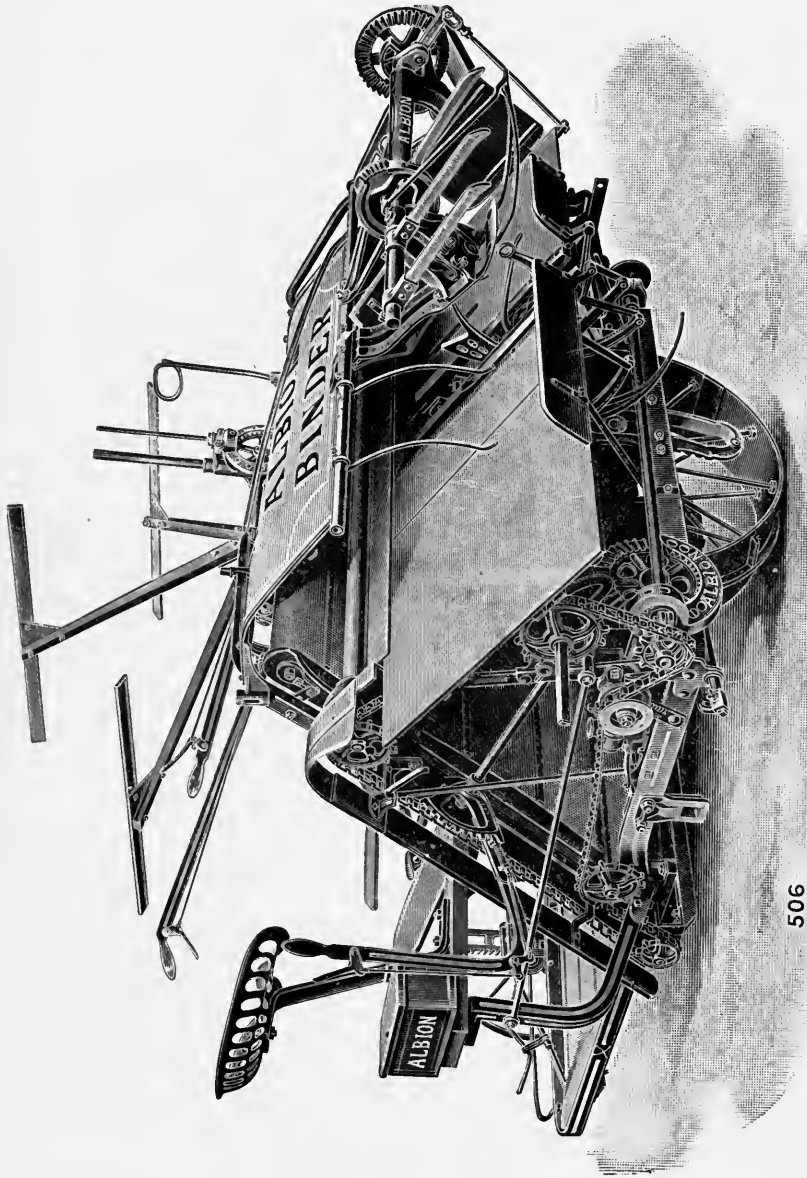


Fig. 304.—Hornsby's Indispensable Reaper.

is the sheaf-binding reaper, which was in use in the United States for some years before it was taken up to any considerable extent in this country. It was first made by Messrs. McCormick, Wood, and other



American manufacturers, to bind with wire. This was objectionable, not only because the wire was somewhat troublesome to cut when



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Fig. 305.—Harrison, McGregor & Co.'s Binder.

threshing was going on, but also, and more seriously, because pieces of wire were apt to get into the straw, and to be cut up when chaff was

prepared for live stock. After a few years the binders were adapted for string, which constituted a great improvement.

It was not until the "eighties" that binders came into extensive use in this country, and since that time they have been vastly improved in efficiency. In figs. 305 and 306, we illustrate two among several excellent machines manufactured by different firms. Since their introduction, improvements in the working parts have been constantly made, so that it is difficult to conceive how they can be further improved, unless it be in the direction of enabling them to deal better than they

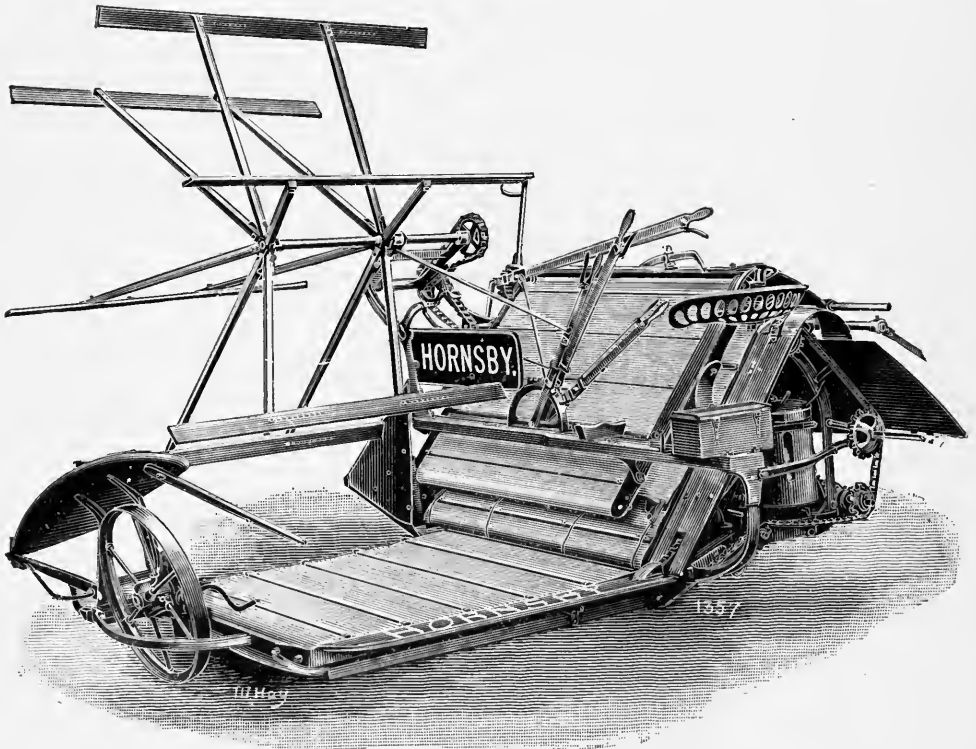


Fig. 306.—Hornsby's Binder.

can at present with laid and twisted corn. In some seasons, when the crops have been badly beaten down by heavy and repeated storms of rain, and twisted by strong winds, binders or other reaping machines cannot be used to cut them to advantage.

The chief advantage derived from the use of binders lies in the quickness with which corn can be cut, bound, and set up in shocks, rather than in the saving of expense in harvesting. This, however, is an advantage of very great value, not only because it affords an opportunity of getting crops out of the danger of damage from wet weather more

quickly than when corn is cut by hand or even by a reaper which does not bind the sheaves, but also because it enables growers to cut all their corn before it is dead-ripe, and in danger of serious loss from the shed-

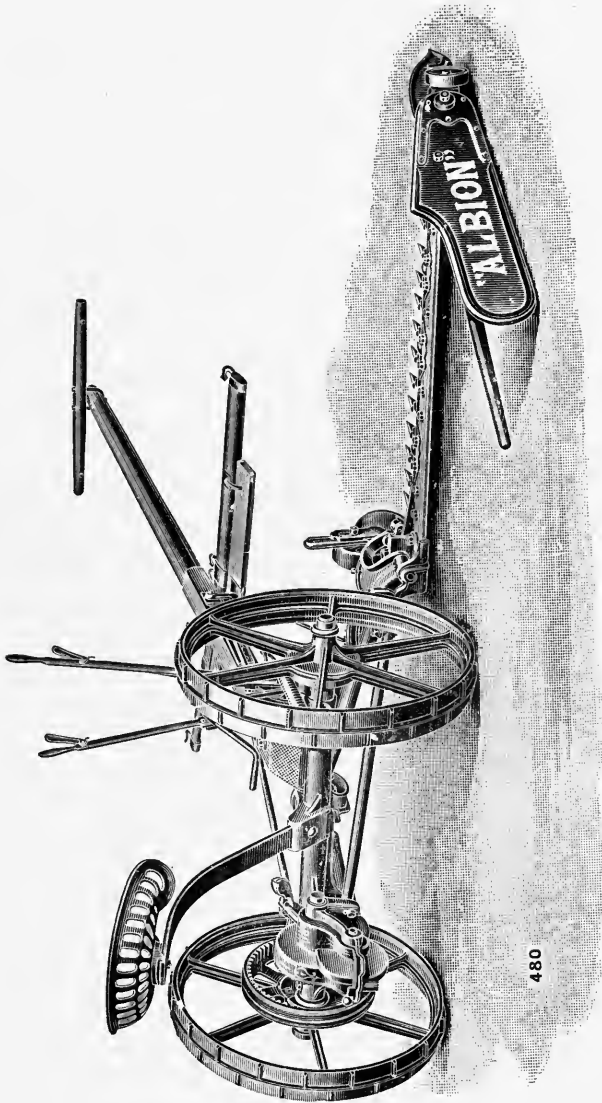


Fig. 307.—Harrison, McGregor & Co.'s "Albion" Mower.

ding of grain. Moreover, as the number of men employed regularly on farms has been greatly reduced in recent times, and extra hands are more difficult to obtain than they were formerly, it would be impossible

to harvest the crops now quickly enough to avoid great losses in any but continuously fine harvest periods, which are of rare occurrence. Indeed, it may be said that such settled periods of fine weather never occur for the harvesting of crops in all parts of the United Kingdom, as that work is usually spread over at least three months, and sometimes over a longer period.

Grass mowers have almost entirely taken the place of the scythe in hay-making, and are now constructed on simple plans, and yet combine great strength and durability. Messrs. Harrison, McGregor & Co.'s Albion (fig. 307) is a good illustration of the modern mower; but there are many others. Indeed, the improvement of mowers has been so general that nearly all makes are at least fairly satisfactory. Grass mowers are often made so as to be readily converted into manual-delivery

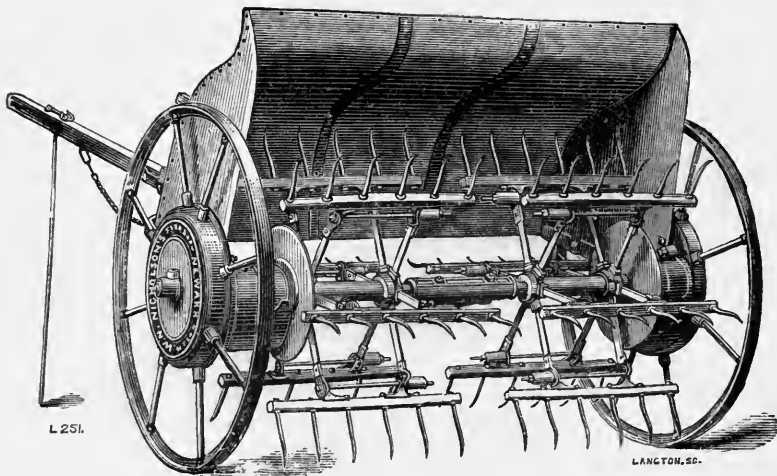


Fig. 308.—Nicholson's Haymaker.

corn reapers; but although it is a great advantage in seasons when the corn is much storm-broken and twisted to have at command a handy machine to cut out the worst pieces, for the ordinary reaper is rather too big to do this conveniently, a combined machine is not as well fitted for corn cutting as a manual-delivery reaper.

Hay-making machines are now considered absolutely necessary in the hay-field, for they are able to get through a large amount of work in a short time, thus doing away with the necessity of keeping on a number of extra hands during showery weather, in order that they may be available when the sun shines. These machines also do the work much more thoroughly than men can be got to do it. The implement illustrated in fig. 308 is made by Messrs. Nicholson & Son, Newark, and is fitted with two motions—a forward one to toss the hay completely over, and a backward one to ted it lightly. The hood is

removable, and is used to prevent the hay from falling on the horse while the forward motion is in progress. There are several well-known makers of these machines, among whom Messrs. Howard, Messrs.



Fig. 309.—Nicholson's "Snapdragon" Horse Rake.

Ransomes, and Messrs. Blackstone rank high. Smaller machines with one motion, for tedding only, are much used.

Horse-rakes are implements which have been greatly improved during the past few years. Some years ago Messrs. Nicholson & Son added another to their list of successes with these machines by in-

roducing the Snapdragon rake (fig. 309). Very efficient machines have for some time been in use with automatic action for freeing the rakes of the collected grass: these, however, generally had slight

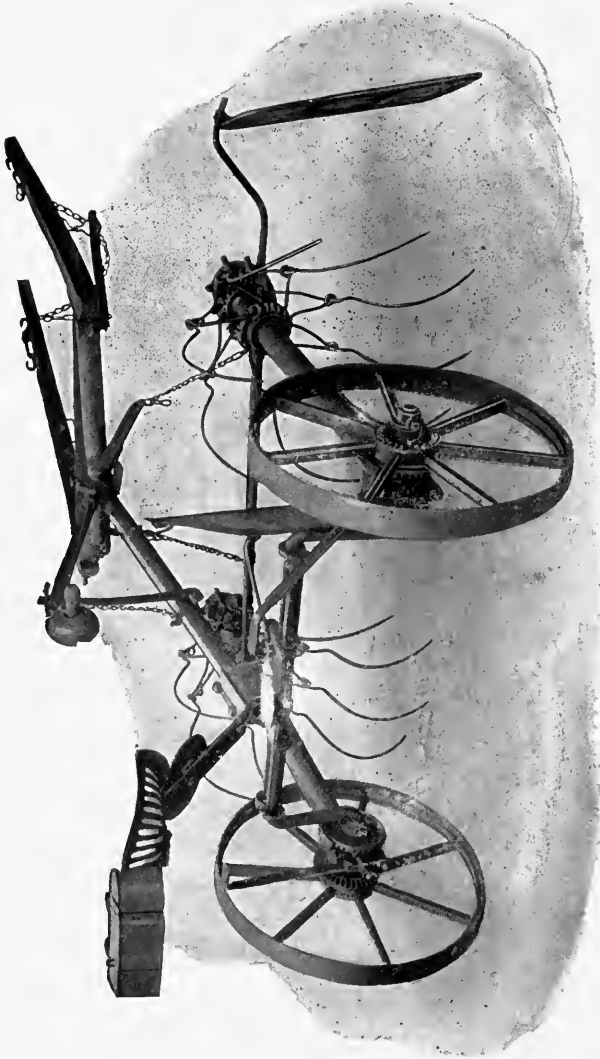


Fig. 310.—Blackstone's Swath Turner.

drawbacks in the way of springs, or friction bands, which are rendered unnecessary where the "Snapdragon" catch is used. The action of this rake may be briefly described as follows:—A very slight pressure of the driver's foot on the pedal, when riding, or a very easy lift of the

back lever when walking, allows the pawls to engage with the ratchet wheels, and the teeth are raised so as to deliver the collected grass.

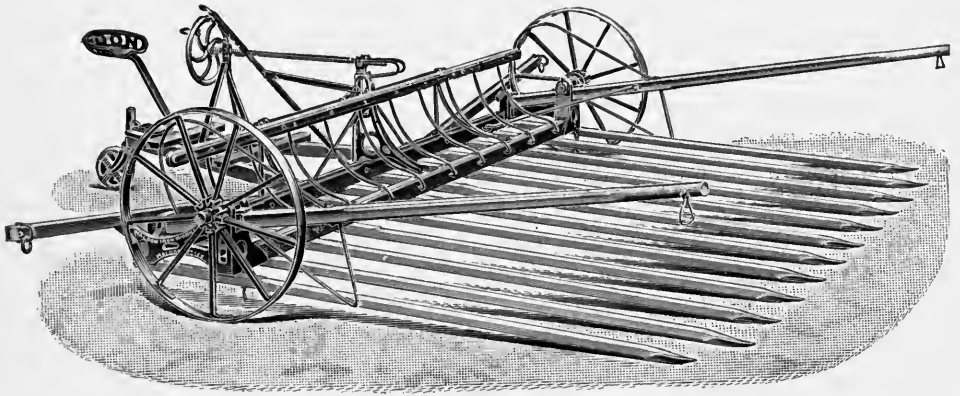


Fig. 311.—Mugleton's Hay Sweep.

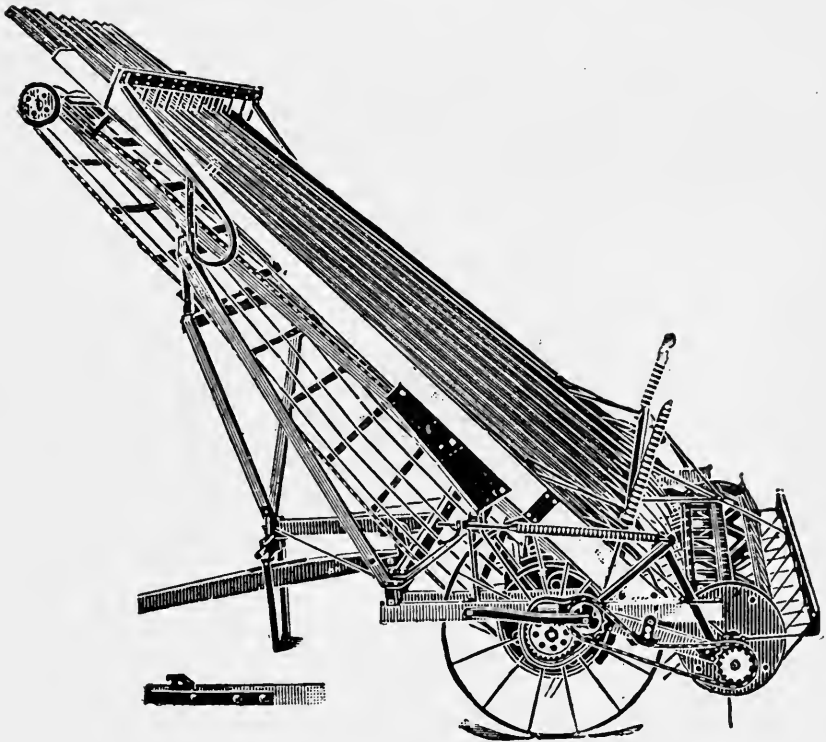


Fig. 312.—The "Deere" Hay Loader.

The rake having delivered its load, the teeth fall of their own weight with a steady and sufficiently quick descent to get well through and under the hay, so as to ensure a good load and clean raking. It is here that the ingenious action of the "Snap" is brought into play.

Swath turners have come much into use in recent years, and there are many varieties in the market. Fig. 310 illustrates one made by Messrs. Blackstone & Co., of Stamford, who were awarded both first and second prizes in the Royal Agricultural Society's trials in 1907.

A great labour saver is the hay gatherer represented in fig. 311, manufactured by the Maldon Iron Works Co., Maldon, Essex. Taking a width of 14 feet, it sweeps the hay up to the stack, where it can be dealt with by the elevator or horse pitchfork.

The hay loader shown in fig. 312 is another great saver of labour. It can be attached to any waggon, and it picks up and places on the vehicle as the latter moves along hay from the swath or the windrow. It is sold in this country by the International Harvester Co., of 115 Southwark Street, London. The only objection to its use is the extremely arduous work of the men on the waggon, in loading the hay rapidly thrown on.

#### CARTS AND WAGGONS.

In fig. 313 we illustrate the improved farm waggon made by Messrs. Woods & Co., Stowmarket. In spite of argument to the effect that the



Fig. 313.—Woods & Co.'s Light Farm Waggon.

single-horse cart is by far the most economical mode of conveying farm produce, the waggon is still more generally used for carting hay or corn in England, though not in Scotland.



In figs. 314 and 314a we depict a combined tipping and harvesting cart in common use in Scotland, showing two forms of harvest frames. They are made by Messrs. Jack & Sons, of Maybole, N.B. There are special harvesting carts of much larger dimensions; but those shown carry as much corn or hay as can be fairly drawn by one horse.

There are several different forms of attachments for tipping carts which would be worth illustrating were there space. As this is limited,

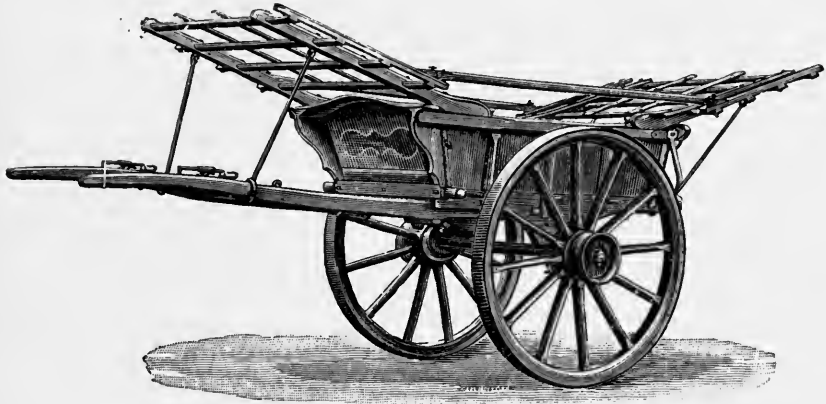


Fig. 314.—Jack's Tipping Cart with Harvesting Ladders.

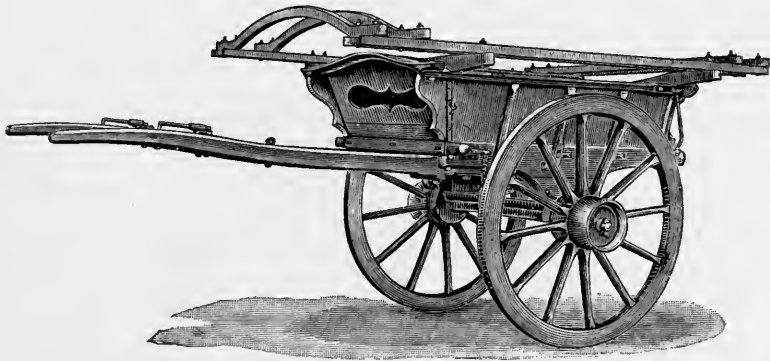


Fig. 314a.—Another Form of Harvesting Frame.

we only give the illustrations in figs. 315 and 316, showing Margetson & Hek's patent screw tip cart, made by the Bristol Waggon Works Co., of Bristol. By means of the screw, the cart can be held in position at any angle for tipping manure, and when entirely tipped it does not quite touch the ground. It is shown also with harvesting ladders attached.

Rick-stands or staddles are useful in preventing rats and mice from

getting into the stacks, whilst they allow the wind to draw all round and under the stacks, so that there is no musty corn at the bottom, as is so often the case when they are in contact with the ground. Simple

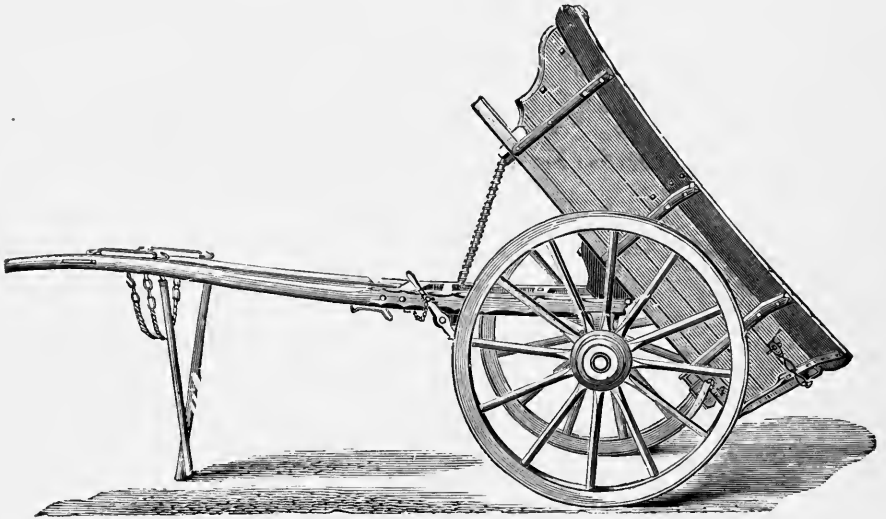


Fig. 315.—The Bristol Waggon Works Co.'s Spring Tip Cart.



Fig. 316.—The same Cart with Harvesting Ladders.

ones may be constructed of wood mounted on stone pillars, but it is more usual now to employ iron, and the illustrations in figs. 317 and 318 represent two very good forms; they possess the advantage that they

can readily be taken to pieces and stowed away when not in use. The circular frame as in fig. 317 was invented by Mr. John Springall, and the rectangular form (fig. 318) is made by Messrs. Bentall, of Heybridge.

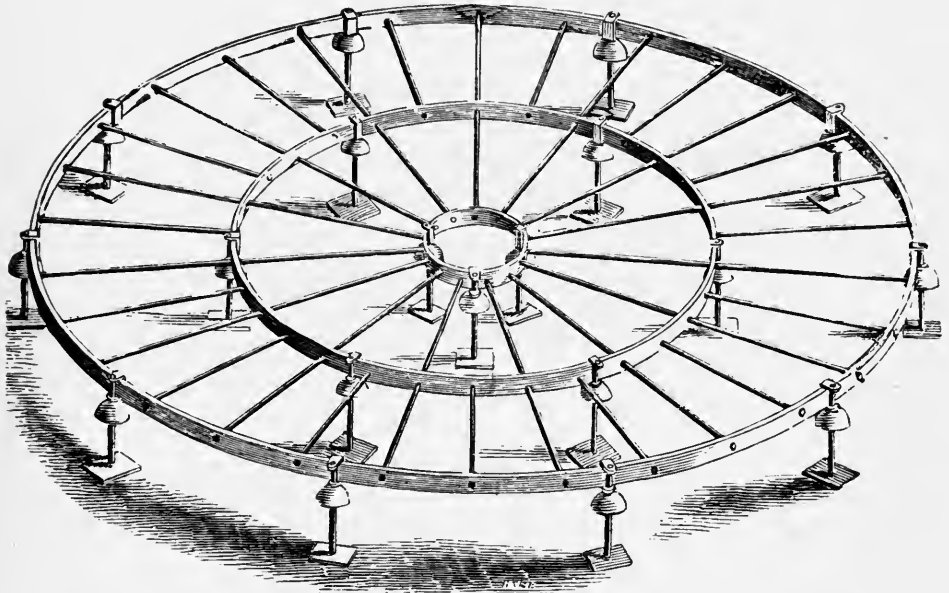


Fig. 317.—Circular Corn Rick-Stand.

The conversion of grass and other green-stuff into silage had a great rage some years ago; but very little of it has been done recently in this country. In some of our colonies and in the United States, however,

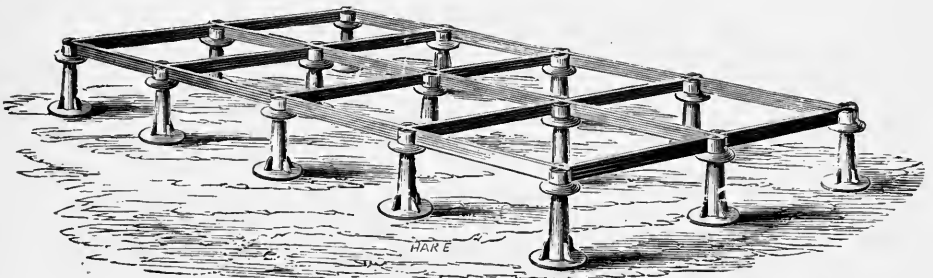


Fig. 318.—Rectangular Corn Rick-Stand.

the system appears to be in more general use than ever, especially for maize and other coarse feeding-stuffs, which are not suitable for hay. Although no one, probably, would choose to make silage when he could make good hay, it is certain that good silage is preferable to bad hay,

and it is surprising that the former is not more commonly made than it is in this country in wet seasons. Second crops of clover and grass, moreover, as well as coarse herbage from waste land, might be made into satisfactory silage when they cannot be converted into good hay. Partly for this reason, and partly for the information of colonial and foreign readers, we retain the description of the system given in our last edition. At first it was considered necessary that an expensive air-

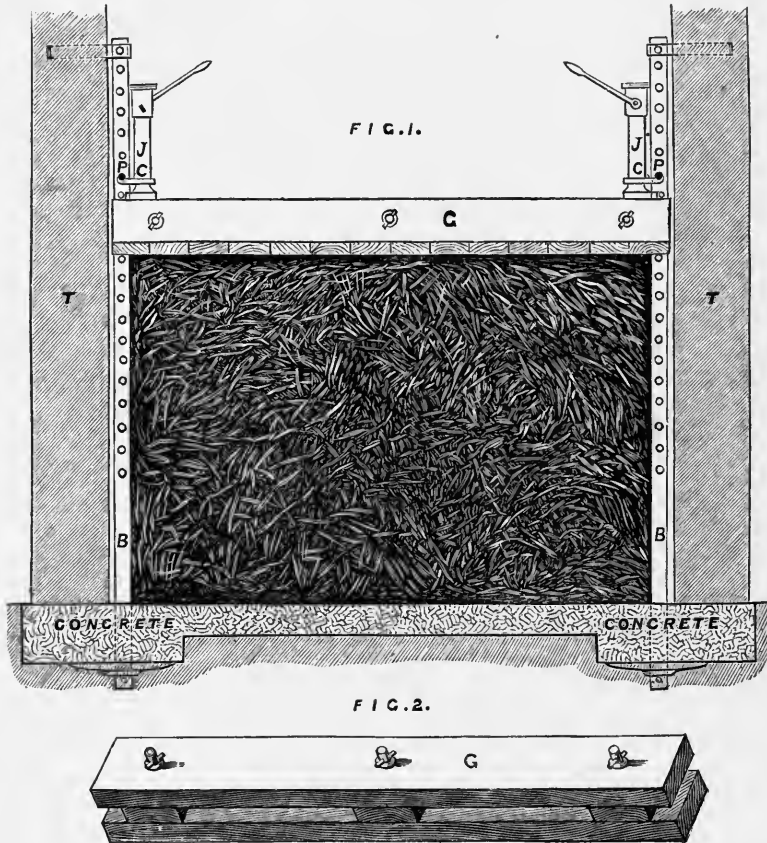


Fig. 319.—Wilson's Furcated Hydraulic Jacks as applied to a Silo.

tight underground building—a genuine silo—should be set apart for the process, as it was expected that the lateral pressure would burst any ordinary walls, but it was soon shown that the difficulty was to get the pressure sufficiently to the outside, as the shrinkage was always towards the centre. Hence, silos came to be built above ground, but the cost of these buildings was prohibitive of the rapid extension of the system. It has since been proved that even air-tight buildings are unnecessary,

provided the air is excluded by means of pressure, so that open-air silage-stacks are becoming very much used, and are likely to increase in popularity. At first, pressure was applied in the silo by means of dead weights, from 75 lb. to 200 lb. to the square foot being considered necessary, but mechanical aids were soon forthcoming to save labour, such as Stock's press and others still in use. It is chiefly through the open-air methods that ensilage is likely to become even more popular than it is; but we give an illustration of a very good method of applying pressure in a silo, which is equally applicable to stacks.

Fig. 319 represents the section of silo and the means by which



Fig. 320.—Wilson's Furcated Hydraulic Jacks as applied to Silage Stacks.

Mr. Christopher W. Wilson's Furcated Hydraulic Jacks are applied to silos. T represents the side walls; G, the compressing beams; B, compressing bars; J, hydraulic jacks; C, furcated claw; P, steel pin. The compressing bars B pass through a concrete foundation, and are made fast by a large iron washer and cotter. These bars should be placed about 6 ft. apart, the first pair 18 in. from the end walls: thus, if the silo is 15 ft. long, three pairs of bars will be required; if 27 ft., five pairs; and so on.

Fig. 320 represents Wilson's Furcated Hydraulic Jacks at work on a silage stack. After the foregoing description of its application in silos there is no need to give further explanation.

Johnson's Ratchet-Drum Press (fig. 321) is one of the best-known

methods of compressing stacks. By means of wire ropes great pressure can be brought to bear on the stack. The ratchet-drums have to be attached to stout planks: these are let into the ground so that the upper sides are flush with the surface, 3 feet apart, centre to centre, and long enough to project 2 feet beyond each side of the stack. The timbers must be exactly 8 in. deep, and should not be less than 6 in. wide; a few pieces of timber should be laid crosswise on these near both outsides, to prevent the timbers from pulling up into the stack, as is shown in fig. 321. Messrs. Reynolds, Messrs. Blunt, and others have brought out very useful forms of presses.

The most recent mode of making silage stacks is to cart the material into a clamp, and make a heap like a drawn up dung-hill, the pressure of the horses and carts consolidating it in the first instance, and a

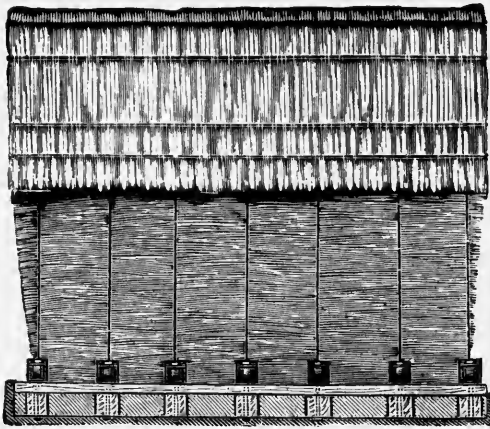


Fig. 321.—Johnson's Ratchet-Drum Press.

field roller being used subsequently. Occasionally the silage-clamp is merely covered with earth or straw, but final weighting and covering is now very frequently done by stacking hay or corn on the top, whereby the waste on the upper surface is reduced to a minimum. In making silage, whether in the pit or in the stack, fresh layers should always be put on within three days of each other until the whole is complete, or mould will form. The sides of stacks should also be pared and put up on the top within the same time, so that the amount of waste at the sides may be reduced as much as possible. Mould will always cause some waste at the sides, but mould only develops so far in as the air can penetrate; if, therefore, the sides are pared to the solid, so that there is but little opportunity afforded for the air to enter, the amount of waste will be correspondingly small.

## CHAPTER VIII.

STEAM ENGINES—THRESHING MACHINES—CORN-DRESSING MACHINES—  
MILLS—BRUISING MACHINES.

*STEAM ENGINES.*—The flail is now so rarely used that it may be said that practically all corn is threshed by machinery. Modern farm-buildings are not adapted to the use of the flail, but it is not altogether a bad plan to employ it occasionally, and we know first-rate farmers who still call it into requisition to some extent on their farms. This is not done because of cheapness, for the cost is greater than when the steam threshing machine is used; but it finds work for men in winter when it would be very difficult to employ them, and it induces them to stay on the farm all the year round, and thus ensures a supply of labour in the busier seasons. The straw undoubtedly makes better fodder, and animals greatly prefer it, whilst some crops, such as peas, are less broken, and are therefore better for seeding purposes than when put through the threshing machine. Still, very little corn is now threshed by the flail; and, with the perfection which threshing machines have reached, the flail will probably entirely disappear with the generation which at present uses it.

Although on the majority of farms it is most convenient to use motors or portable engines, yet when there is sufficient work, fixed machines are employed with advantage. Fig. 322 represents a very powerful engine, made by Messrs. Ransomes, Sims & Jefferies.

As many farms do not provide sufficient work for a large engine, it is found cheaper to hire for the threshing. But as there are various other classes of work which can be done very economically by a moderate-sized engine, a small vertical engine and boiler, such as is shown in fig. 323, made by Messrs. Hindley, of Bourton, is found very useful for preparing food either by grinding, pulping, or chaff-cutting, and for supplying steam for cooking, cheese-making, and other work of common occurrence on the farm.

It is to be observed that all the leading agricultural engineers now turn out engines of very high class, and have enormously reduced the consumption of fuel. Fig. 324 represents a portable engine of very high repute, manufactured by Messrs. Marshall, Sons & Co., of Gainsborough. It is made with one or two cylinders, and many recent improvements are embodied in its construction. The same may be said of the engine of Messrs. Ransomes, Sims & Jefferies, of Ipswich, mentioned above, and of their excellent locomotive agricultural engine shown in fig. 325.

Nowadays farmers are not at all disposed to cart threshing machines and portable engines about from farm to farm, and consequently those

who let such machines for hire are constrained to use traction engines. Messrs. Ransomes, Sims & Jefferies make special engines for continuous traction on roads; but the one illustrated is designed particularly for driving and hauling threshing machines, for steam cultivation, sawing,

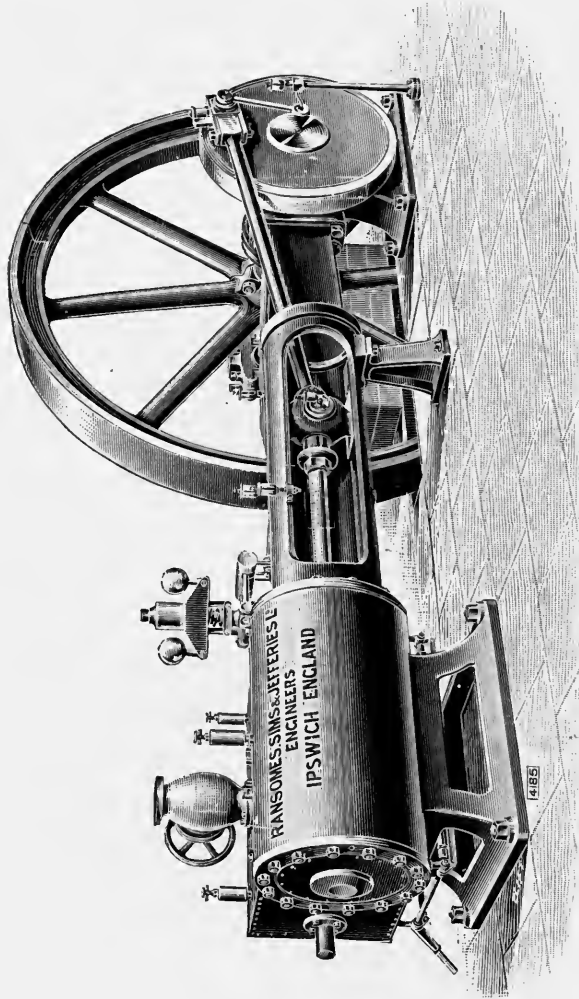


Fig. 322.—Ransomes' Long-Stroke Engine.

pumping, transporting agricultural produce, and, in short, for all purposes to which steam can be adapted as a motive power in farm work. It is simple and easy to manage, so that a skilled mechanic is not needed to drive it. It is a double-cylinder engine, and is made in 6, 7, and 8 horse-power. The designs from which it is constructed embody improvements



suggested by prolonged experience in the supply of this class of machinery. Many other firms than those named manufacture excellent steam engines of the several forms, and those selected for illustration are taken as typical of some of the best of their classes.

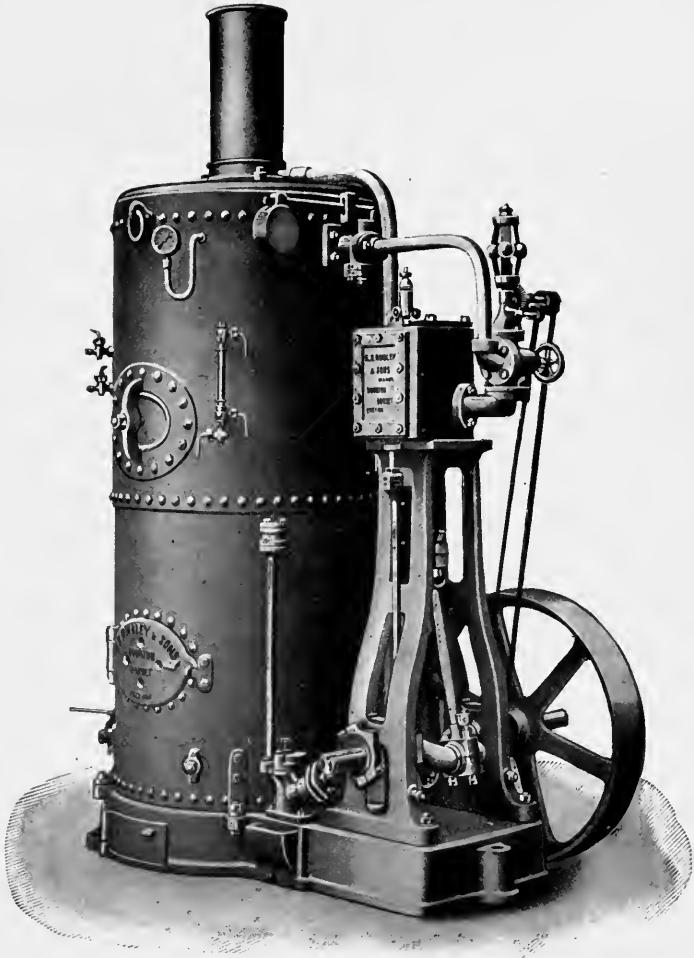


Fig. 323.—Hindley's Vertical Steam Engine and Boiler.

We have already noticed oil motors, and it remains to refer briefly to fixed oil engines, which are now in extensive use for various purposes on farms. There are many excellent engines of this class in the market, and the one shown in fig. 326 is selected because it is specially designed for farm use, the makers having won the first prize in trials carried out

by the Royal Agricultural Society some years ago. It has been improved in detail since that time, but remains as simple and as easy to work as it was when first brought out.



Fig. 324.—Marshall's Portable Engine.

There are many districts where water power is to be had in abundance, and where it could be utilised with great economy as a motive agent by means of turbines. Turbines are not only suitable for situations where ordinary water-wheels cannot be used, but possess, besides,

many very important advantages over them, among which may be enumerated their cheapness in first cost, and their having fewer parts

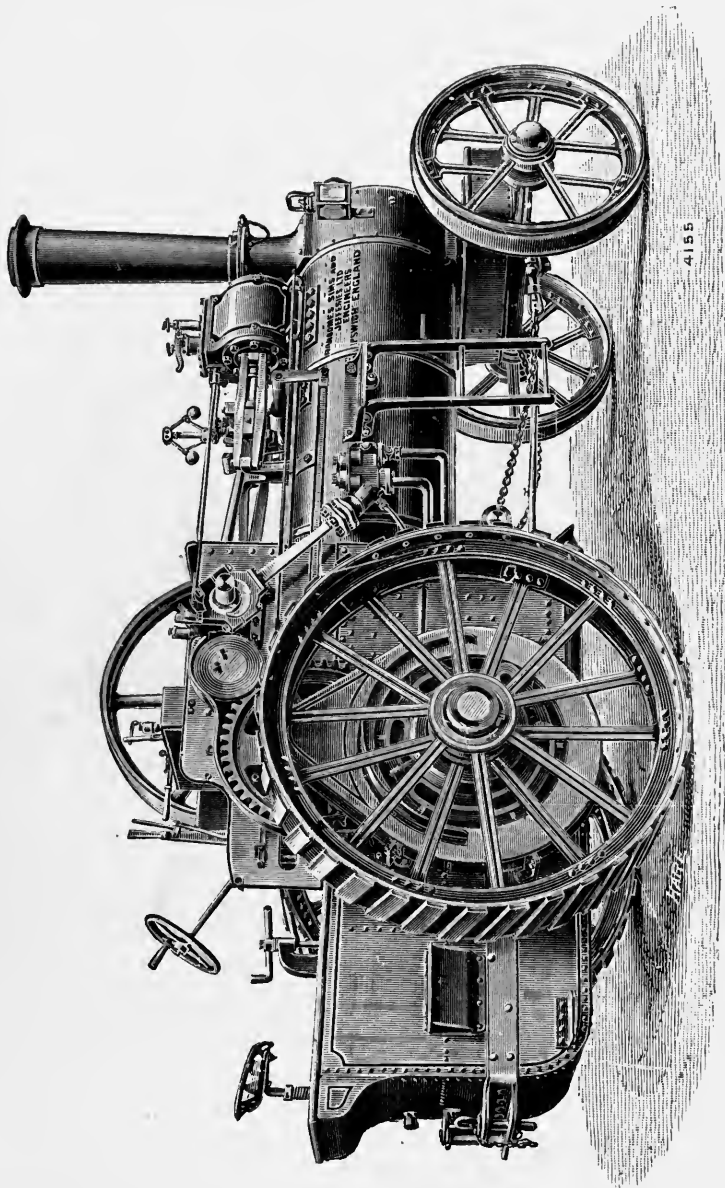


Fig. 325.—Ransomes' Agricultural Locomotive Engine.

liable to get out of order ; they may be applied to all heights of falls, and are more economical in repairs ; they occupy very small space, and

require no expensive foundations or gearing to get up the speed necessary for the driving of the machinery.

Messrs. Gilkes & Co., of Kendal (Canal Iron Works), manufacture the forms of turbines invented by Professor Thomson, of Belfast, which have gained, under the name of the "Vortex," the highest reputation for efficiency, and other forms as well.

Messrs. Gilkes give attention to the circumstances of each case in which a turbine is required, and recommend the form best suited thereto. Where there is a good and regular flow of water, a cheap class of turbine will serve; but, if it be necessary to obtain as much power as possible from a small flow of water, a more expensive machine will usually be found necessary.

As a rule, to which there are exceptions, for falls below 10 ft., Messrs. Gilkes recommend a turbine with vertical shaft, such as the Kendal,

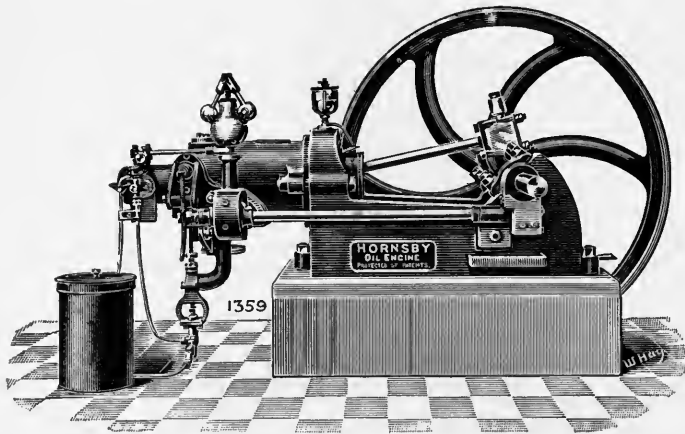


Fig. 326.—Hornsby's Oil Engine.

represented in fig. 327. For falls of 10 ft. to 100 ft., either the Double Vortex, with horizontal shaft, shown in fig. 328, or, if a very large quantity of water has to be dealt with on a comparatively low fall, a Twin turbine consisting of two single discharge wheels of the Kendal or similar type, keyed on to one horizontal shaft, and placed in the same case or shell. For falls above 100 ft., the Pelton wheel shown in fig. 329 or a turbine named the Girard, is deemed most suitable.

After an experience of many years, Messrs. Gilkes have come to the conclusion that the best vertical shaft turbine for low falls, where capital outlay has to be considered, and a comparatively high speed is desirable, is the design which they have named the Kendal, an improved form of the Lunedale, which they have made for many years.

In the Kendal wheel some of the water is passed through an upper set of cast-iron buckets and discharged through a central tube. There

are thus two sets of buckets, the lower set being of stamped steel cast into the above-mentioned central tube and an outside ring. This wheel is capable of developing a larger horse-power than any of the other wheels of the same diameter. The comparatively small diameter of wheel required for a given power and fall is in most cases an advantage, as the high speed thereby obtained reduces the cost of the gearing, and there is also some saving in space and smaller structural alterations are needed. The guides, which are of cast iron, can be adjusted to suit the

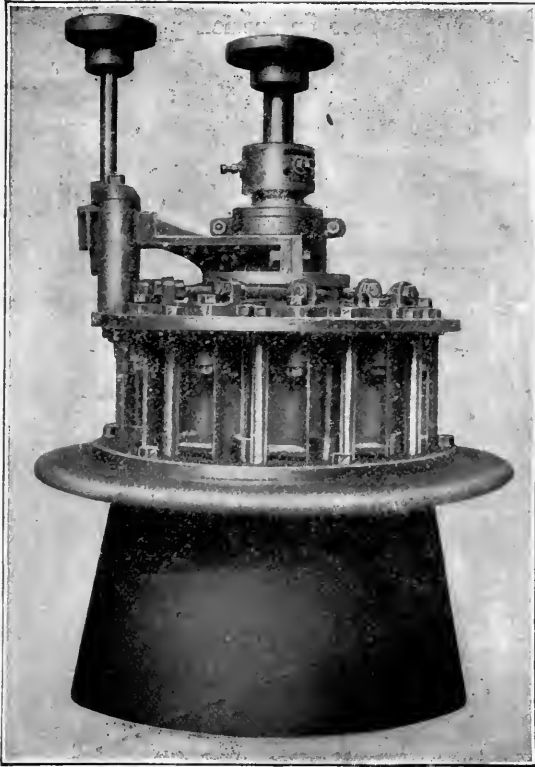


Fig. 327.—Gilkes & Co's Kendal Turbine.

quantity of water available or the power required, consequently the turbine works very efficiently with a reduced quantity of water, the best result being obtained at about seven-eighths of the maximum opening. The guides are practically balanced and are therefore easy to operate, and hand-gear can be supplied for working them in any convenient position.

The fact that the water is only discharged below the wheel frequently very greatly lessens the masonry alterations necessary when a water-

wheel is replaced by a turbine. A double discharge turbine, as a rule, has to be completely submerged below the standing tail water level before it will work efficiently, hence a deep pit must be excavated when the turbine is a fairly large one, and every foot of depth greatly increases the risk of coming across springs or causing trouble with the neighbouring foundation. This question of foundations should always be considered in comparing prices of turbines. Provided the turbine has a good head of water above it, there is no difficulty in making the platform upon which it is placed, several feet above the tail water level, where it is a convenience so to do, the additional fall being used by means of an extension of the draft tube or suction pipe. Another advantage of

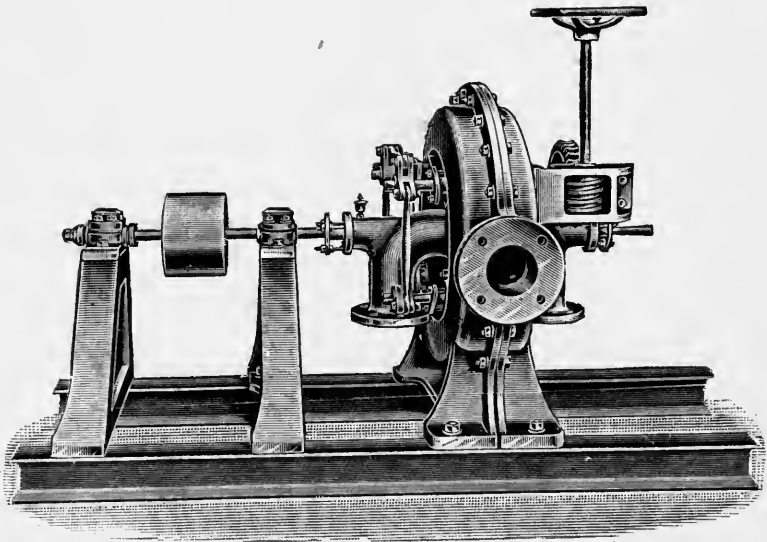


Fig. 328.—Gilkes & Co.'s Double Vortex Turbine.

this type is that when the head water is shut off at the sluices the turbine is left dry on its floor, and can thus be readily inspected.

In the case of the Double Vortex the water enters the outside casing at the top—or in any other position that may be convenient—and passing thence is directed by four (or more) guide blades on to the outer circumference of the revolving wheel, which is driven round at a velocity depending on the height of the fall. The water, having expended its energy in giving motion to the wheel, is discharged through the two central openings, half the amount being carried away by each suction pipe. The guide blades are movable, and turn about on a pivot placed near their inner ends. In any application of water power, there are certain losses of effect which are unavoidable; but in the Vortex, by various improved arrangements and adaptations, their amount is

materially less than in turbines of some varieties. The power is obtained with a slower velocity of the water than in ordinary turbines. This is effected by a peculiar balancing of the centrifugal force of the water in the revolving wheel against the pressure due to half the head, so that only one-half of the fall or head is employed in giving velocity to the water, the other half acting simply in the condition of fluid pressure. Hence the velocity of the water in no part of its course exceeds that due to one-half of the fall, and the loss from fluid friction and agitation of the water is thus materially less than in other turbines where the water is required to act at much higher velocities.

Although high falls are uncommon on agricultural estates or farms, there is a demand in some cases for a simple and efficient water motor

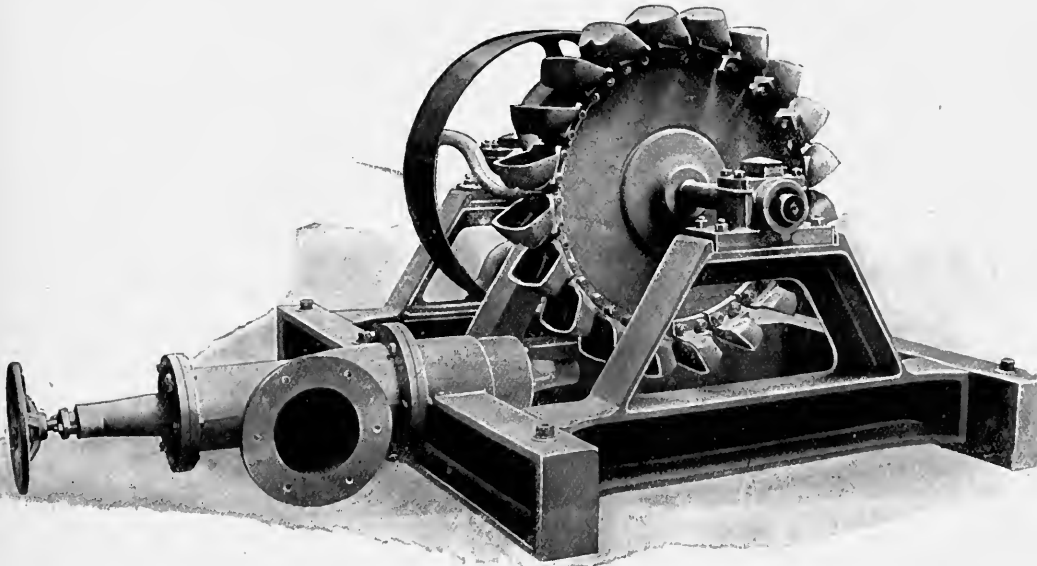


Fig. 329.—Gilkes & Co.'s Pelton Wheel for High Falls.

suited for such falls. The high speed of inward flow turbines under great heads of water being unsuitable for conveniently disposing of the power, the need has arisen for a turbine wheel the diameter of which may be increased without diminishing the efficiency. The Pelton wheel, which is a development on scientific lines of the "Miner's" or "Hurdy-Gurdy" wheel, meets the above-mentioned requirements admirably. The water impinges from a nozzle on to a number of bifurcated buckets fastened round the periphery of a pulley. These buckets can be fixed, and the nozzles changed to suit requirements, by any intelligent labourer. Notwithstanding the simplicity of the machine it is essential that great attention should be paid to proportion in design, and to the workmanship, if the best efficiency is to be obtained.

Leffel's double turbine water-wheel (fig. 330), manufactured by Messrs. Gordon & Sons, of London, is a first-rate machine, and has a deservedly high reputation. Hydraulic rams are very useful where there is sufficient fall of water near to work them.

The necessity of a good supply of water wherever stock are kept, especially if dairying is practised, is so great, that we illustrate one or

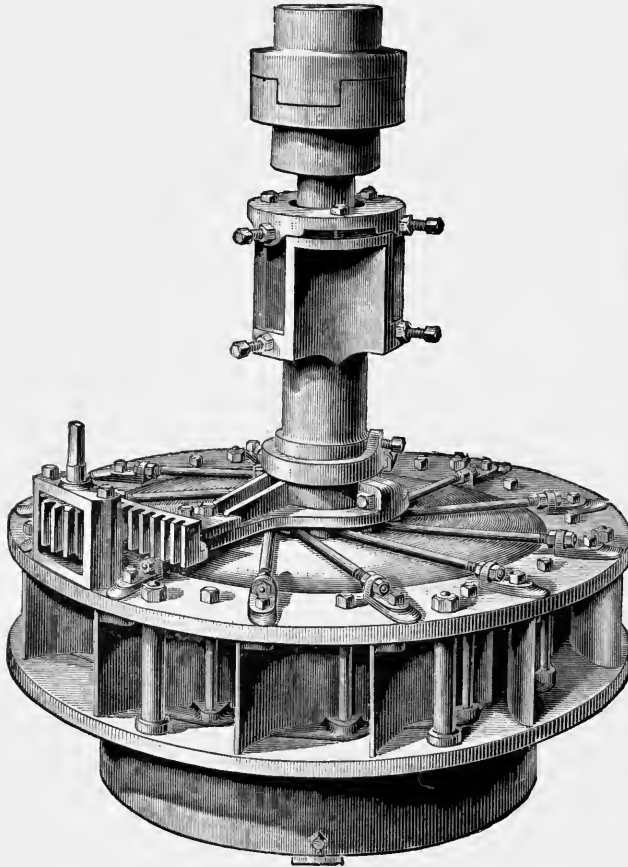


Fig. 330.—Leffel's Double Turbine Water-Wheel.

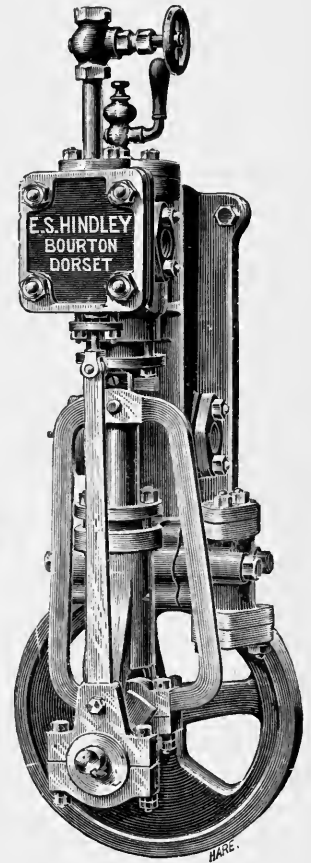


Fig. 331.—The Bourton Donkey-Pump.

two more methods of raising it. A very useful engine, shown in fig. 331, Hindley's Bourton Donkey Pump, is an even-working machine, easily fixed. In fig. 332 we illustrate one of the deep-well pumps manufactured by Messrs. Warner & Co., of 97 Queen Victoria Street, London. Pumps of this class are of service in chalk districts, where it is often necessary to penetrate to a great depth for water.



The Abyssinian pump is extremely useful where the water lies near to the surface, in which case there is no cheaper or more convenient means of obtaining a supply (for illustration see p. 696). Various forms of chain pumps are made, and are employed for emptying tanks which contain floating matter in the liquid, as they are not so liable to choke as ordinary suction pumps.

In recent years, wind engines for pumping and various other purposes, long used in the United States, have come into extensive use in this

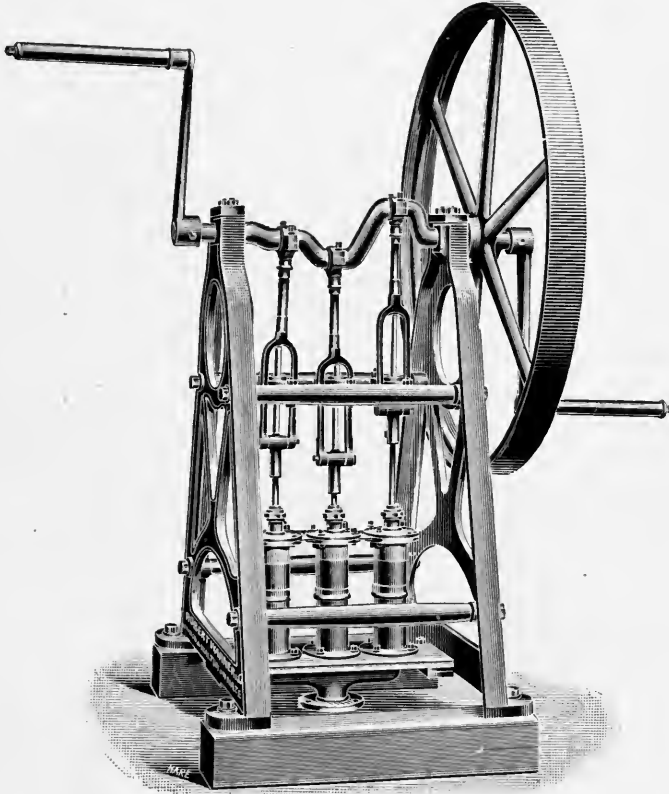


Fig. 332.—Messrs. Warner & Co.'s Deep-Well Pump.

country. Fig. 333 is an illustration of the one which gained the first prize in the exhaustive trials carried out by the Royal Agricultural Society in 1903. Its inventors and manufacturers are Messrs. Goold, Shapley & Muir, of Brantford, Ontario, and the English agents are Messrs. Rickman & Co., 13 Walbrook, London. The report of the judges of the trials in the *Journal of the Society* for 1903, described this wind engine as “clearly ahead of all others in nearly every point,” including efficiency as determined by the quantity of water pumped,

successful governing automatic application of the brake, economy in upkeep due to slow motion and good workmanship, and reasonable price. The second prize was awarded to Messrs. Thomas & Son, of Worcester, whose wind engine was highly commended on almost identical points, and declared distinctly superior to any of the other competing machines, excepting the first prize one. It is quite possible, however, that some of



Fig. 333.—Goold, Shapley & Co.'s Wind Engine.

the other makers have greatly improved their wind engines since the trials were held.

*Threshing Machines.*—Threshing machines are now made to do all the operations necessary in threshing and preparing corn for market. We give in fig. 335 an illustration of Messrs. Marshall's well-known threshing machine (which was awarded the first prize in the trials held by the Royal Agricultural Society at the Cardiff Show), as seen from

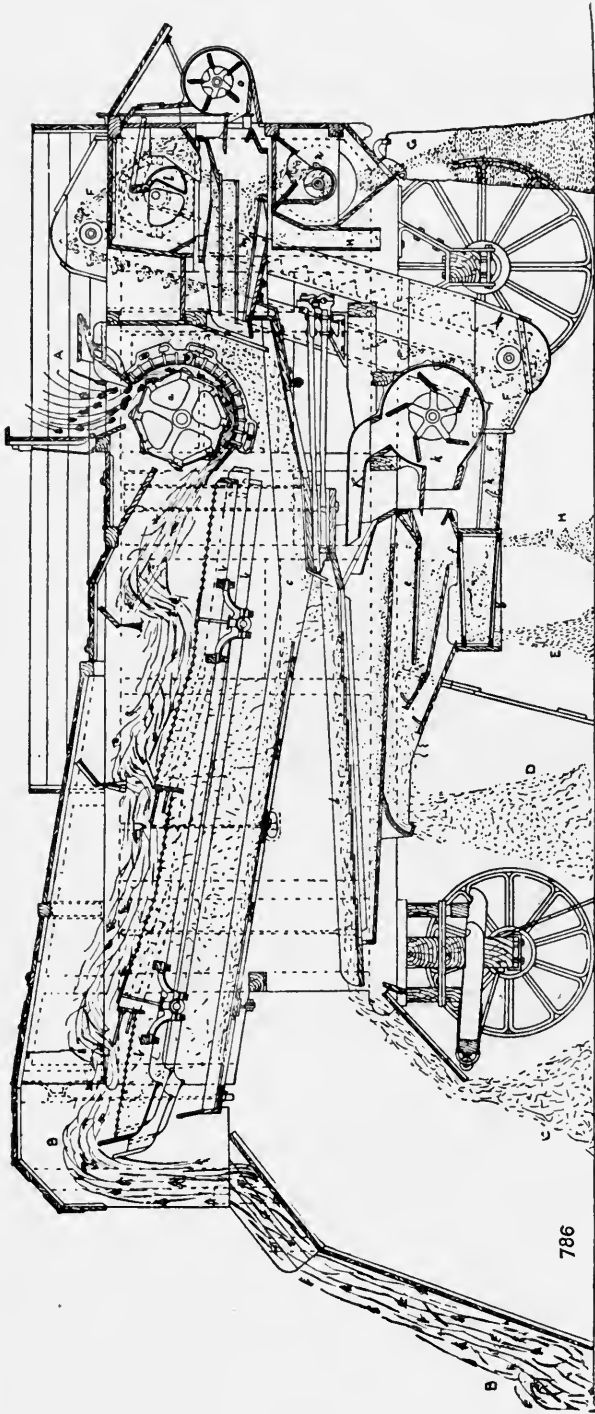


Fig. 334.—Sectional View of Marshall's Finishing Threshing Machine.

- |                    |                   |                   |                       |
|--------------------|-------------------|-------------------|-----------------------|
| E. Cobs.           | Drum.             | f. Caving Riddle. | l. Smutter.           |
| F. Corn.           | b. Shakers.       | g. Seed Screen.   | m. Finishing Riddles. |
| G. Finished Grain. | c. Top Shoe.      | h. Corn Spout.    | n. Separating Screen. |
| H. Dust.           | d. Caving Riddle. | j. Elevator Tins. | o. Back End Blower.   |
|                    | e. Chaff Riddle.  | k. Main Blower.   |                       |

- |                     |
|---------------------|
| A. Unthreshed Corn. |
| B. Straw.           |
| C. Cavings.         |
| D. Chaff.           |

the outside, and in fig. 334 the course of the corn can be easily followed through the machine, of which a sectional view is given. It will be seen that the corn enters the machine at the mouth, where it is caught

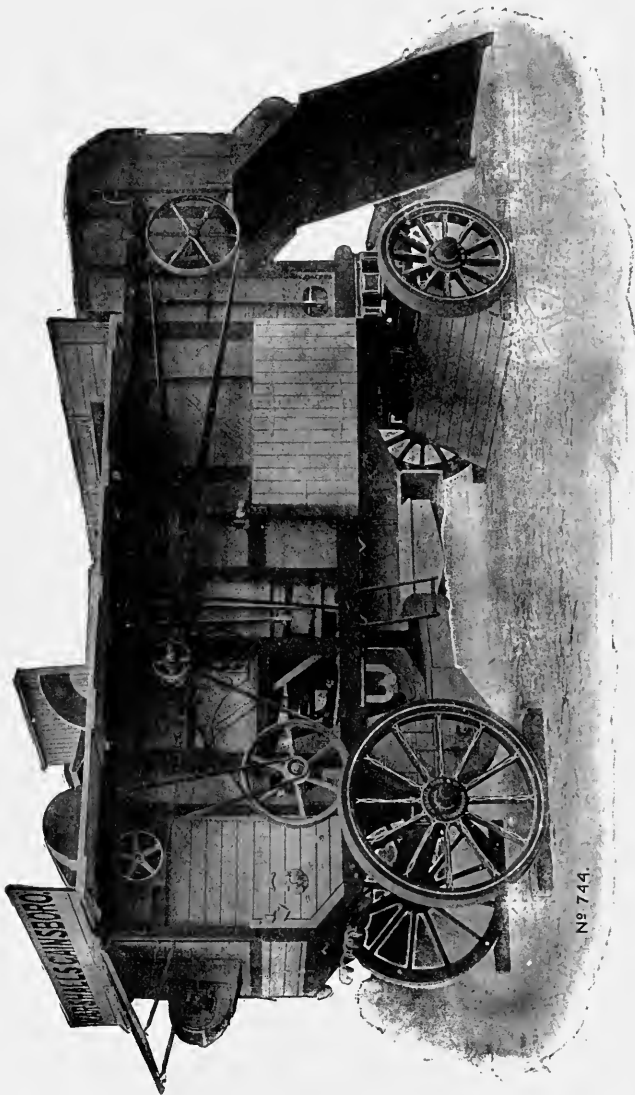


Fig. 335.—Marshall's Finishing Threshing Machine.

by the beaters of the drum *a*, and is threshed out between these and the concave. The straw travels from the drum over an arrangement of shaker boxes which are lathed to allow any grain remaining in the straw, together with the cavings, chaff, and dust, to fall through on to

another portion of the top shoe *c*. These materials, together with what has passed through the breastwork or concave, then pass from the top

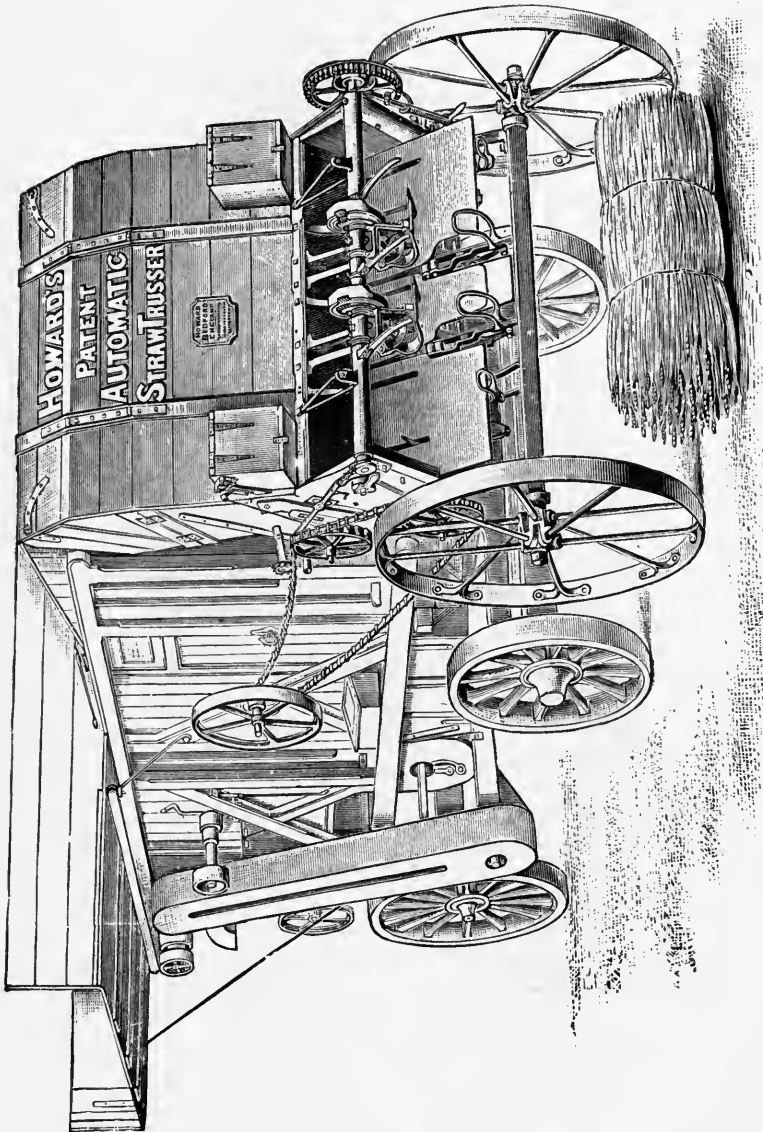


Fig. 336 — Howard's Straw-Trusser.

shoe over a series of riddles. The first of these riddles is the caving riddle *d*, which separates the cavings and the coarse chaff from the grain, and allows these to travel over the front end of the riddle as shown at *c*,

the blast from the spout connected to the main blower *k* assisting in this separation. The separation of the chaff from the grain takes place in the bottom hopper by means of a chaff riddle *e*, where the chaff is

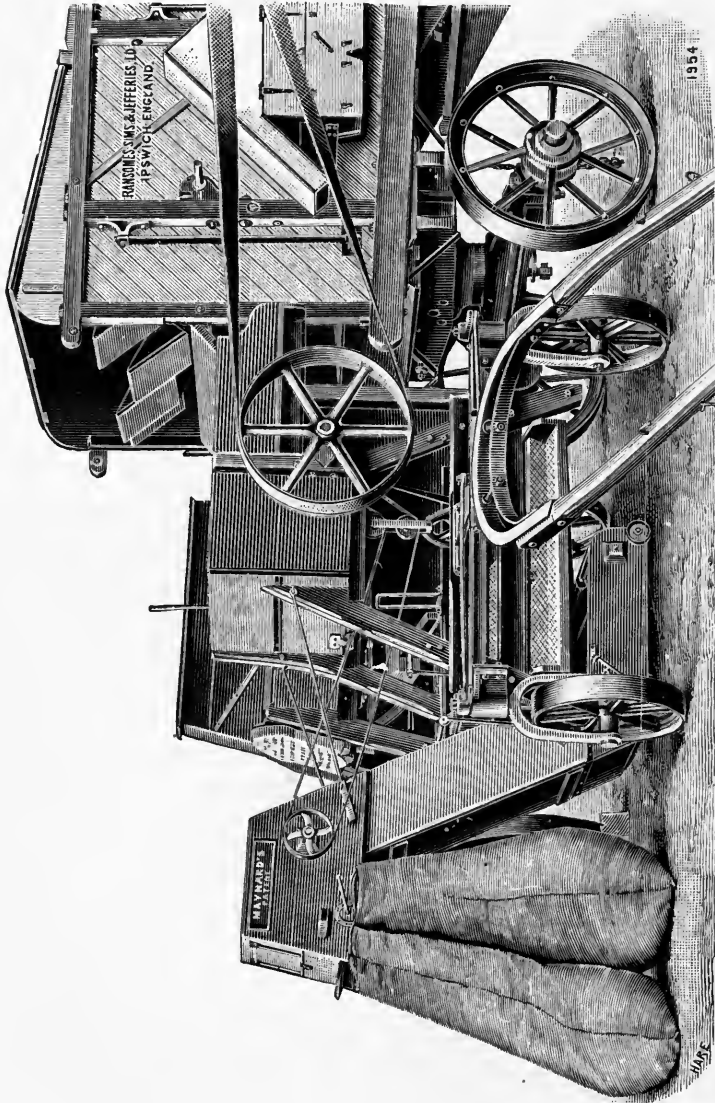


Fig. 337.—Chaff-Cutter attached to Ransomes' Threshing Machine.

acted upon by the main blast from the blower *k*, and blown out at the front of the hopper on to the ground under the machine as indicated at *D*. Any cobs or dust remaining amongst the grain are then dealt

with, suitable sieves *f* and *g* separating these and delivering them as shown at E and H. The grain then passes along the corn spout *h* into cup elevators *j*, which convey it to the top part of the machine, where, by means of an arrangement of tips, it can be conveyed into a smutter to improve the sample, if necessary, and thence on to the back end dressing riddles *m*, or direct on to the riddles, without being put through the smutter, where it is finally dressed, any remaining dust or dirt being separated by means of these riddles and the blast from the back end blower *o*. After passing these finishing riddles, the grain is delivered into a rotary adjustable screen *n*, which grades the grain according to size, and delivered through the openings provided for the purpose into three separate sacks. When threshing beans it is not, as a rule, considered necessary to pass these through the elevators, and provision is made for delivering the beans from the corn spout *h* by means of a small hinged door on the underside of the spout. When the chaff is required

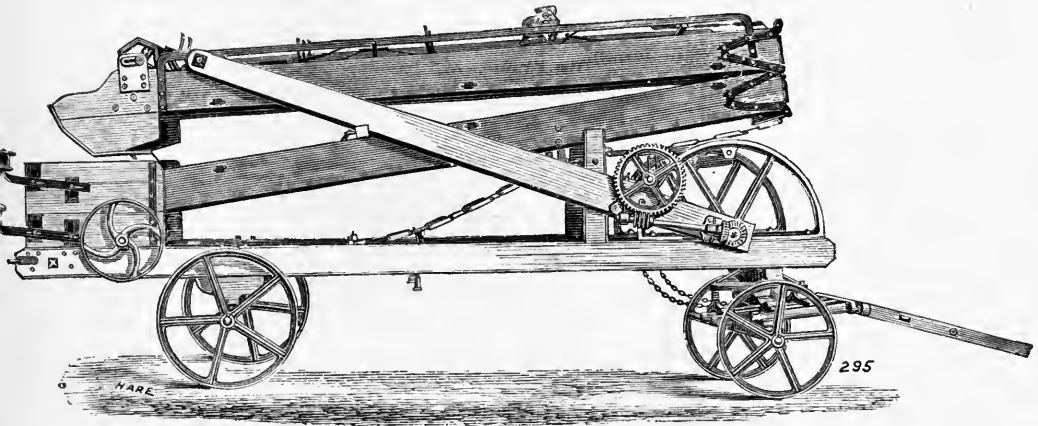


Fig. 338.—Hornsby's Stacker or Straw-Elevator folded for Travelling.

for feeding, it can be delivered into a bag, if a necessary adjunct is obtained.

An extremely popular machine attached to the ordinary threshing machine is shown in fig. 336. It is Howard's straw-trusser for tying up straw as it comes from the shakers. It is an adaptation of the tying apparatus of the corn-binder. It is a great labour-saving machine, and also preserves the straw, whether it is desired to sell it or to keep it on the farm. The illustration shows it as part of the threshing machine, but it is made in a portable form suitable for working with any threshing machine.

*Clover-Rubbers.*—In districts where clover is allowed to go to seed the clover-rubber is an important machine. The clover is first threshed by the ordinary machine. The portion which comes out where the chaff falls in ordinary threshing contains the seed mixed

with fine chaff, commonly called cob; this is put into the rubber, and rubbed out by being worked through a concave by means of helically-placed bars, something like bicycle tires fixed by a skeleton frame to a spindle running through the centre; these fit close to the concave and rub the seed out as they revolve. The motion draws the cob to the outside of the concave, but until recent years a solid worm was used. Recently the several makers have very much improved the sifting arrangements, whereby a much greater amount of work can be done.

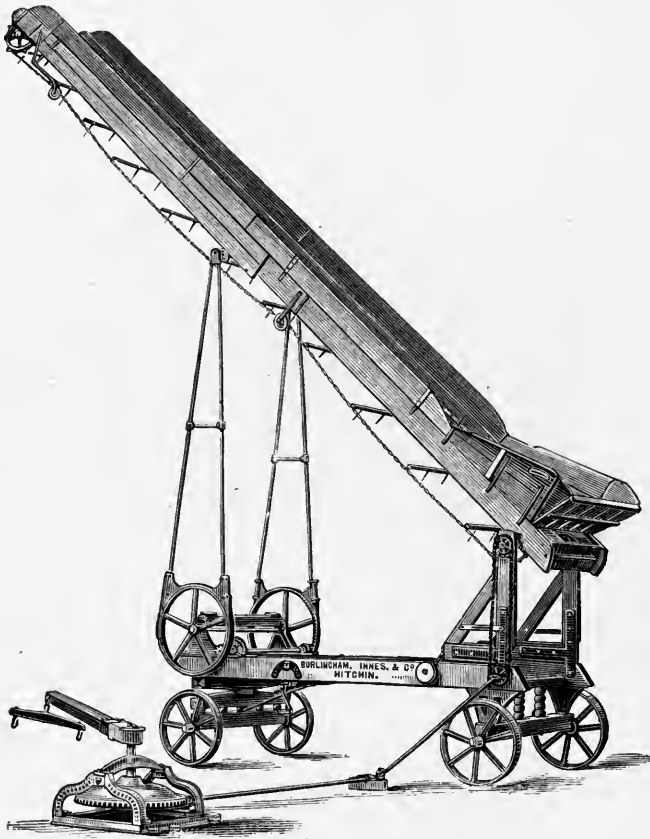


Fig. 339.—Innes & Co.'s Stacking Machine, or Elevator.

In fig. 337 a chaff-cutter is represented as working behind a threshing machine. The straw falls from the shakers to the feeding platform of the chaff-cutter; whereby all yelming or handling of the straw, except by the feeder, is avoided, with great saving of expense. The chaff-cutter is driven from a strap fixed to the main pulley of the threshing drum, the main shaft of the drum being elongated to allow of the attachment of the extra pulley.



The straw-elevator is very generally used in conjunction with the threshing machine, as well as to lift sheaves, or loose corn or hay, on to stacks; in the latter case horse-gear is required, and couplings are attached in the place of the driving pulley. There are many different methods for raising and folding them, but those on principles such as the one represented in fig. 338 are particularly good, because there is so little to get out of order, and there is less danger of accidents than with those which are raised by means of longer poles. The figure shows the machine folded in readiness for travelling. Without the alteration even of a chain, all that is necessary, to put it into working condition, is to turn the raising-handle, and by means of the worm and worm-cog the pole is raised, and the upper portion is brought over so that the trough is thrown out to its full length. By

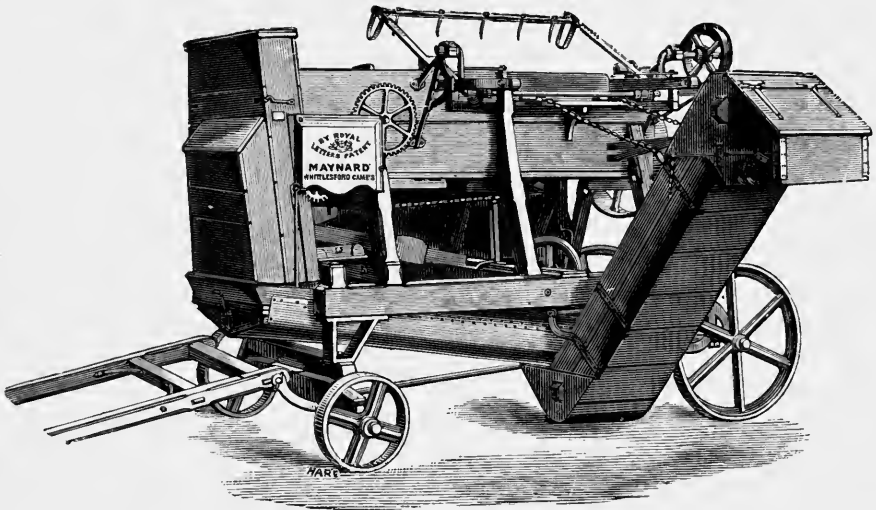


Fig. 340.—Maynard's Mammoth Self-Feeding Chaff-Cutter.

fixing a pin in the middle of the trough, the whole becomes rigid; when it is only necessary to wind again, and the entire trough rises, so as to give a throw 30 ft. in height. The lowering and folding are effected by reversing the operations.

Another ingenious form of stacking machine, or elevator, is made by Messrs. Burlingham, Innes & Paternoster, of Hitchin, its distinctive feature being that, by gradually raising the hopper at the bottom end of the trough, the top end of the latter is kept continuously above the middle of the stack, as a result of which the delivery takes place throughout over the middle of the stack, and does not tend to approach one side as the stack grows in height. In fig. 339 the hopper is shown raised to the full extent.

Chaff-cutters are now made with five or six knives of sufficient size

self-wiring, and bale-separating baling press for hay, straw, and other materials.

*Corn Winnowers and Corn Screens.*—Winnowing machines are not of quite so much importance as they were, now that threshing machines are made to clean the corn thoroughly; still it is impossible to dispense with them, for it decidedly pays to put all corn on the market in the most perfect condition; and in the hurry of threshing it is often found that the sample is not so clean as it might be. It is also better that the corn from the various portions of the stack should be well mixed,

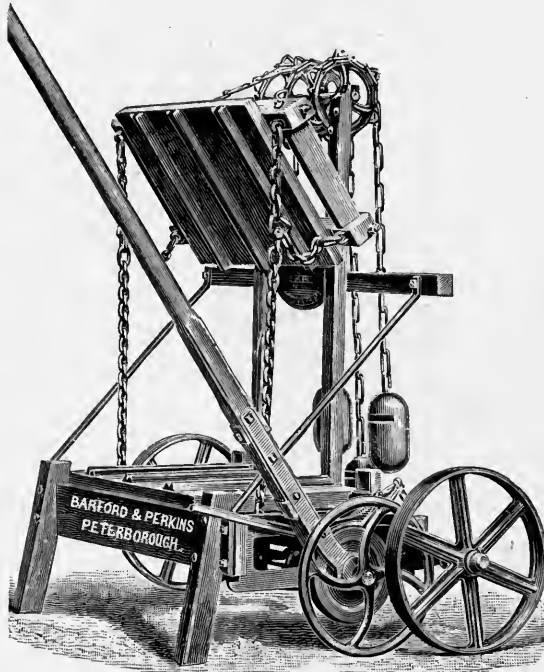


Fig. 343.—Barford & Perkins's Manual Lever Hay Press.

so that the bulk may be uniform, and this is effected by means of the winnowers.

We enter a protest against two alterations which have been made as improvements to meet the requirements of the show-yard. The first is the introduction of wire in the place of perforated zinc, for making screens. The advantage of wire is that it is possible to make the sieves, and therefore the machine, smaller and more convenient for moving through narrow barn-doors, than is the case when perforated zinc is used; for where perforations are made there must be a large amount of the material left to maintain sufficient strength for the sieve to stand the strain that is put upon it. The great disadvantage is that when corn

has sprouted, it is very hard to take all the grown kernels out. When corn grows in the field, or stack, the sprouts shoot out to a considerable length, and malt: the malted sprout curls round, and as it is passed along the sieve it hooks on to the wire, and will neither be shaken nor blown off the top, but after dangling for some time falls through into what should



Fig. 344.—Howard's Hay and Straw Baling Press.

be the cleaned sample and spoils it. Sprouted wheat injures a sample of flour made from it, because that which has grown will not rise when fermented by yeast, owing to the chemical changes which have taken place in it. Grown kernels of barley are injurious to a sample of malting-barley, because instead of sprouting when wetted they mould, and are injurious to the rest. Every farmer knows that a sprouted sample

of either of these cereals is of much less value than the same would be if the grown kernels were not present, even though they may be very few in number; for, in addition to the objections mentioned, the buyer is suspicious of their sweetness, and will not pay the full value for them. If there is one thing more important than another in preparing a sample for market it is that grown kernels should all be taken out. We are glad to notice that Messrs. Cooch & Son, of Northampton, still adhere to the type of machine (fig. 345) which made their reputation many years since.

Another point to which we would draw attention is that convenience has been sacrificed to meet a show-yard requirement as to the height of the hopper from the ground. It is an advantage to keep the hopper low, as it makes the filling easier; but in working the machine it is found to be in reality one of the least important matters, for if the lad

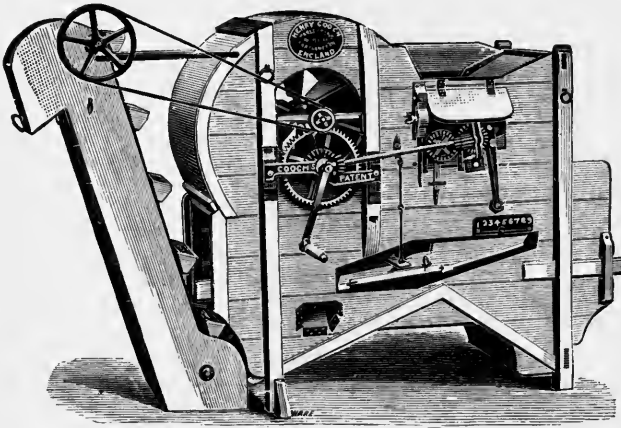


Fig. 345.—Cooch's Dressing Machine.

or man who fills is short it is very easy for him to place a step so that he can keep the machine as full as is necessary, no matter what the rate of working. The place where it is necessary to have the greatest convenience is behind the machine, so that the man who fills the bushel or sack by means of the putting-up sieve is not hindered. Yet in this endeavour to lower the height of the hopper it is rendered absolutely impossible for a man to put up 7 quarters of corn per hour, while with proper conveniences 10 quarters are well within the capacity of a good hand. The mistakes are made by making the delivery board so low that it is impossible to get a sieve under it so that it may be nearly filled of its own accord, and the whole of the corn has to be scooped into it by the man who is putting-up.

The other mistake is in having the concave portion of the machine, in which the fan turns, bulging out so that the man cannot get under

it without going on his knees to fill the sieve. One more protest, and that is, that most winnowing machines are now called such on very slight grounds, as beyond blowing out dust and chaff they do little. When a heap of wheat contains impurities, such as wild onions (garlic), or wild oats, it is very hard to make a good separation, because part of

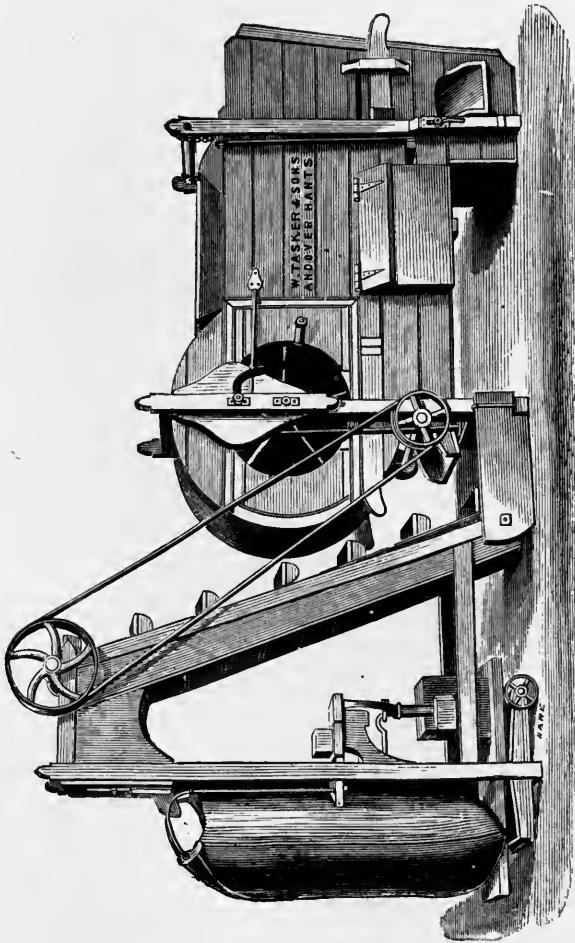


Fig. 346.—Tasker's Winnowing Machine with Corn-Elevator and Weighing Machine.

the impurities owing to their size pass through or remain on the same sieves as the wheat; but they have a different density, and can readily be separated by wind if it is applied under favourable conditions. These latter, however, do not exist in many machines which are practically little else than sifting machines. Taking all things into consideration, and noticing that our experience is corroborated by the

practice of the largest seed-firms, we are of opinion that the winnowing machines with shifting tail-boards and zinc sieves, made on the

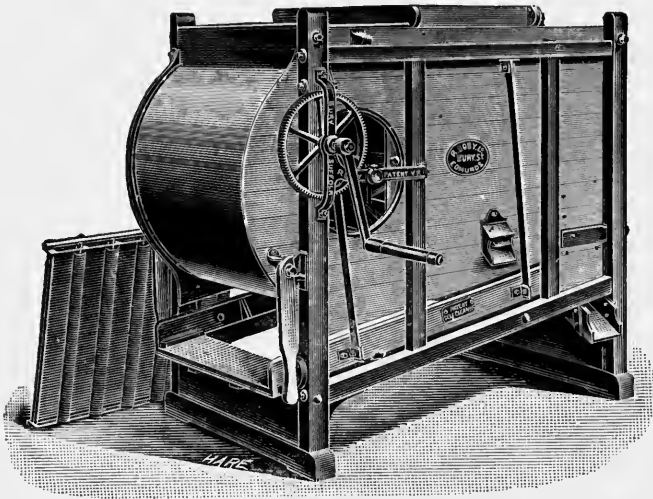


Fig. 347.—Boby's Combined Corn-Dressing and Screening Machine.

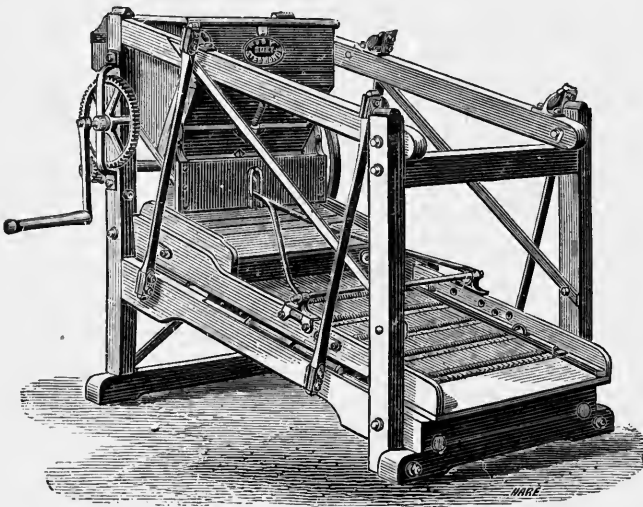


Fig. 348.—Boby's Patent Corn Screen.

principle of Mr. Cooch's dressing-machine, are decidedly better than those which have been made on other lines. So far as preparing

samples with few impurities, or grown kernels, goes, they answer their purpose very well, but they give the impression that those who awarded the prizes to them had taken very little actual part in barn-work.

In fig. 346 we show one of Messrs. Tasker's winnowing machines which is free from some of the drawbacks to which we have referred. A very convenient labour-saving attachment is shown in the combined corn-elevator, sacker, and weighing machine, which is driven from a pulley receiving its motion from the winnower. Another advantage is that the sieves are carried on wood-hangers, thus avoiding friction or liability to get out of order.

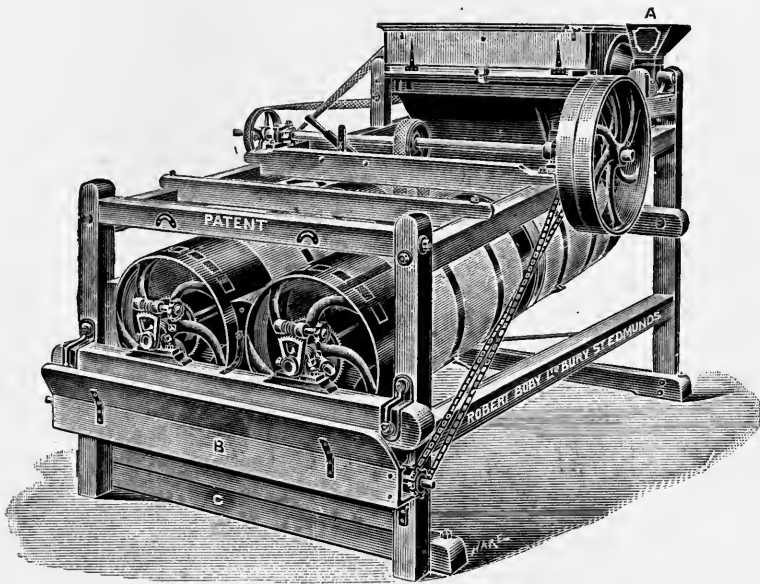


Fig. 349.—Boby's Half-Corn and Round Seed Separator.

Fig. 347 illustrates one of Mr. Boby's combined corn-dressing and screening machines, which is a first-rate appliance. It has one of his patent screens fixed in the place of the ordinary delivery board, thus making an extra separation, which is a great advantage.

The machine shown in fig. 348 is one which introduced a new word into the English language; for farmers and corn-dealers, to express themselves in reference to the operation of cleaning corn by this form of screen, constantly speak of it as "bobyng," thereby conferring upon it a distinction not gained by any other screen. It is now looked upon as a necessity, especially to barley growers and maltsters, as it makes the most perfect separation of any of the ordinary farm machines. The screen is made to reciprocate on wood-hangers attached to a light frame, whereby the friction and wear which were

prejudicial to the earlier machines are avoided, and there is practically no way for it to get out of order.

Fig. 349 represents one of Boby's machines for taking half grains and round seeds out of corn. They are supplied with one or more cylinders to suit the requirements of the buyer, and have proved themselves to be extremely useful for separating cockle from wheat, half-corns from barley, and weed seeds from grass seeds.

*Root-Cutters and Root Pulping Machines.*—The practice of slicing or pulping roots has become very general, even in the fen districts, where



Fig. 350.—Blackstone's Improved Gardiner's Root Cutter.

many of the best stock-keepers until recent years were content to feed their animals on long straw and uncut roots. The advantage of preparing the food is now realised, with the result that far fewer roots are fed whole than was the custom within the last few years. Many forms of slicers and pulpers are in the market, but Gardiner's original slicer, with improvements, loses none of its popularity, especially with sheep-feeders. Fig. 350 represents this well-known machine. The roots are cut by a revolving barrel, with knives so set that when turned





Fig. 351.—Carson & Toone's Slicer.

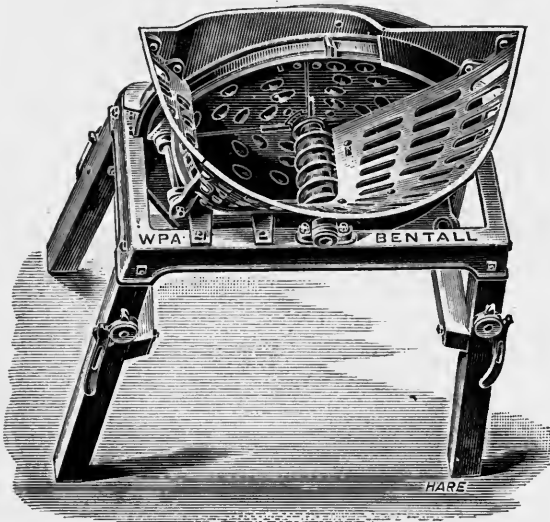


Fig. 352.—Bentall's Unchokable Root Grater.

in one direction it cuts broad slices for beasts, and in the other direction narrow slips or fingers for beasts or sheep. Messrs. Samuelson make a machine with twin-barrels which is a rapid worker.

A very useful slicer, with the knives arranged like the gouges on a nutmeg-grater, is made by Messrs. Carson & Toone (fig. 351), and cuts small strips very suitable for lambs. The drum is made in conical form, so that the roots fall more readily into the knives, and as the greater

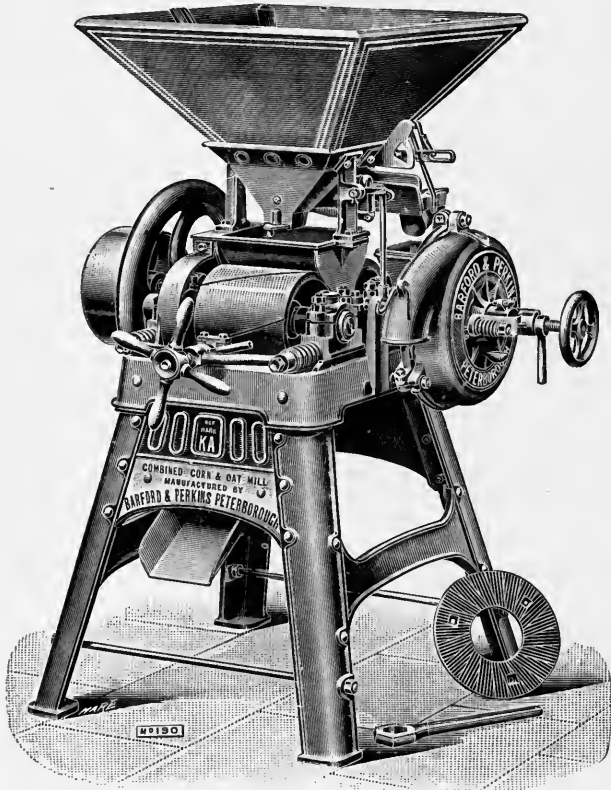


Fig. 353.—Barford & Perkins's Combined Mill.

part of the cutting is done near the axle, the work is accomplished more easily than if it were done at a greater distance from it.

An improved form of root pulper or grater is Bentall's patent unchokable grater (fig. 352), made by Messrs. Bentall & Co., Heybridge, Essex. The arrangement for preventing choking is a great advantage. All these root-cutting machines can be obtained for working either by horses or by steam.

*Corn-grinding Mills.*—Great advances have recently been made in

the machinery for grinding and crushing corn and other substances for feeding purposes. Very little corn is now fed in an unbroken condition, for it is found that, by breaking it, it is much more easily digested; and now that early maturity is considered a necessity, every aid must be given to animals to enable them to assimilate their food without waste of time or energy. Some feeders do not care to reduce the corn to a fine-meal, but think that their stock do better when it is kibbled. One great advantage of meal is that it mixes more intimately with the chaff; and chaff which would not be very palatable is readily eaten when sprinkled with meal which cannot be separated from it, as is the case with heavy grain or coarsely-broken cake. A disadvantage

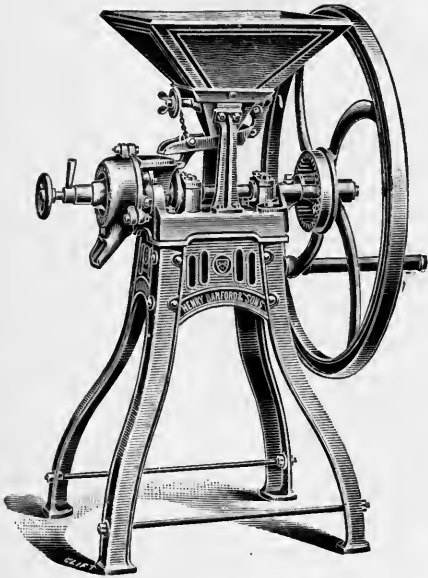


Fig. 354.—Bamford's Grist Mill.

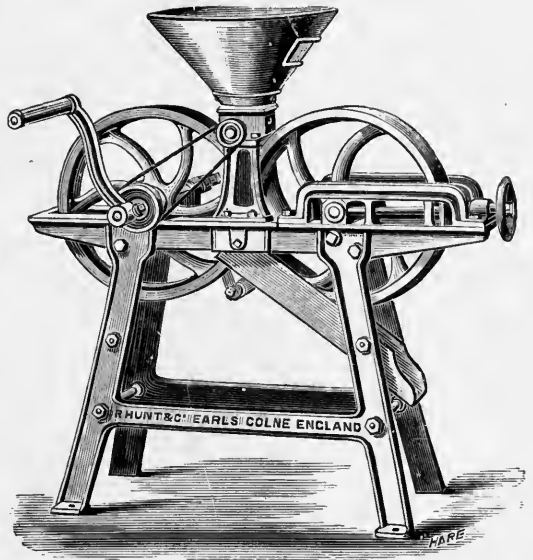


Fig. 355.—Hunt's Smooth-Roller Bruising Mill.

in using too fine a meal is that it is liable to ferment and cause harm if given in large quantities, especially when newly ground, or when it has been left too long and has become musty. Fine meal is better for pig-feeding, as it mixes more easily with water or wash.

In fig. 353 we show one of Messrs. Barford & Perkins's combined mills for crushing oats, malt, and linseed; grinding barley, wheat, or maize; and kibbling beans, maize, or peas.

The grist mill (fig. 354) of Messrs. Bamford & Sons, of Uttoxeter, is a simple and durable machine, made with reversible plates. It is adapted to grinding any kind of grain to whatever degree of fineness may be required for farmers' use.

Messrs. Hunt & Co., Earls Colne, Essex, make the smooth-roller bruising mill (fig. 355) for hand power.

Fig. 356 shows a very useful stone grist mill made by Messrs. R. A. Lister & Co., Dursley. It is suitable for any form of grinding or kibbling done on the farm. There are two stones, one fixed, and one running, the latter being adjustable, and very easily controlled.

Small crushers suitable for small holdings are made by many firms: the one illustrated in fig. 357 is a well-known machine made by Messrs. Lister & Co.

The powerful machine shown in fig. 358 is made by Messrs. Turner,



Fig. 356.—Lister's Farmer's Grist Mill.



Fig. 357.—Lister's "Beaufort Hunt" Corn Crusher.

of Ipswich. They supply similar machines of much smaller size, for hand power, down to a crusher which a boy can work easily.

Machines of immense strength are made for reducing hard and tough materials to a powder. Bones, the hardest decorticated cotton-cake, or any other substance which is generally found to be very difficult to treat, are rapidly and cheaply dealt with. We show in fig. 359 the "Devil" disintegrator, made by the Hardy Patent Pick Co., of Sheffield; and in fig. 360 another form of disintegrator, made by Messrs. Nicholson, of Newark, which can be relied upon to break any substance likely to be met with on a farm.

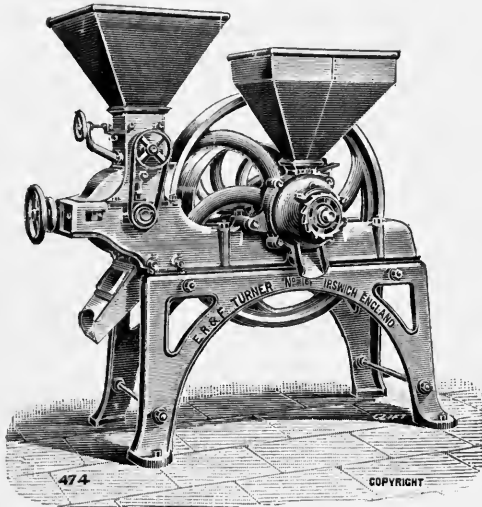


Fig. 358.—Turner's Combined Crushing and Kibbling Mill.

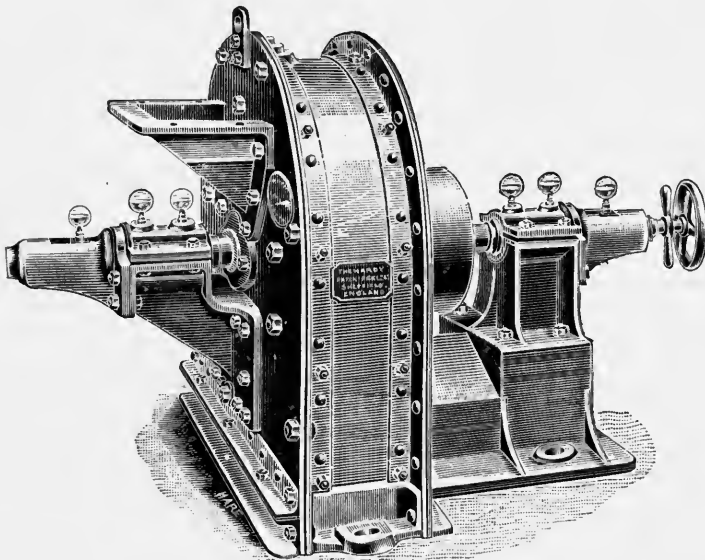


Fig. 359.—The "Devil" Disintegrator.

In an exhaustive report on the trials of grist mills and disintegrators at Plymouth ("Journal of the Royal Agricultural Society," vol. i., 3rd series, 1890, pp. 604—623), Mr. Dan. Pidgeon discusses in detail the two machines just named. The "Devil" disintegrator consists of a pair of grinding rings, one fixed and the other revolving, whose contiguous surfaces are furnished with teeth arranged in concentric circles, and diminishing in size towards the peripheries of the grinding rings, but so disposed that each ring of teeth travels between similar rings of teeth on the opposing annulus, as shown in fig. 359.

"The grinding rings are placed vertically within a strong wrought-iron cylindrical chamber, to which one annulus is bolted while the other revolves at the rate of 800 turns per minute. Adjustment is made, for fine or coarse grinding, by means of a set screw at one end of

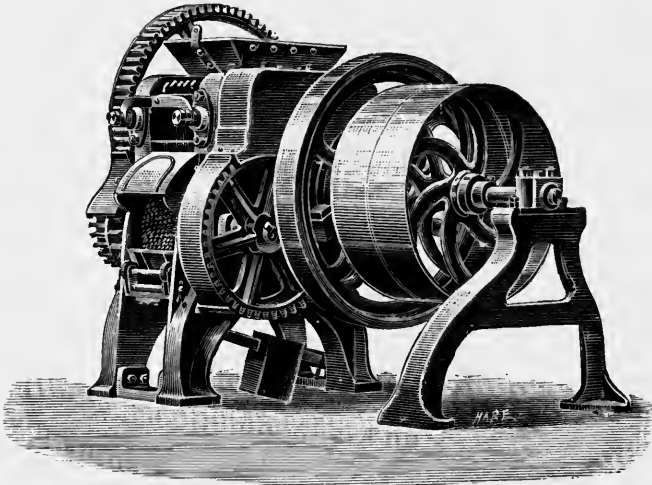


Fig. 360.—Nicholson's Disintegrator and Cake Crusher.

the spindle, operating against the opposing pressure of a spiral spring at the other end of the shaft, which itself is driven, without counter-shafting, by belt direct. All the moving parts of the mill are placed between the bearings, which are very long and adequate. Only three pairs of grinding discs, 'coarse,' 'medium,' and 'fine,' are employed in ranging from the coarsest to the finest work. They are of cast metal, having the teeth deeply chilled, and are ground together with emery for the purpose of trueing up.

"The system of grinding adopted in the 'Devil' disintegrator combines the percussive action of what has been called the 'Collision' mill with a shearing action which, progressing step by step, gradually reduces the material to be operated upon to any required degree of fineness. Meanwhile, although nothing can escape from the mill until

it has reached the predetermined fineness, there is practically no re-grinding, and no loss of power from that cause. Again, the shearing action of the intermitted teeth, each upon the other, enables the machine to operate, whether upon wet or dry, brittle or tough, fibrous or non-fibrous materials. There are, probably, no substances, metals excepted, which could not be disintegrated by this machine, and its power to pulverise a great variety of things has already made the 'Devil' the parent of certain entirely new industries. Among these there is, perhaps, no more interesting example than the conversion

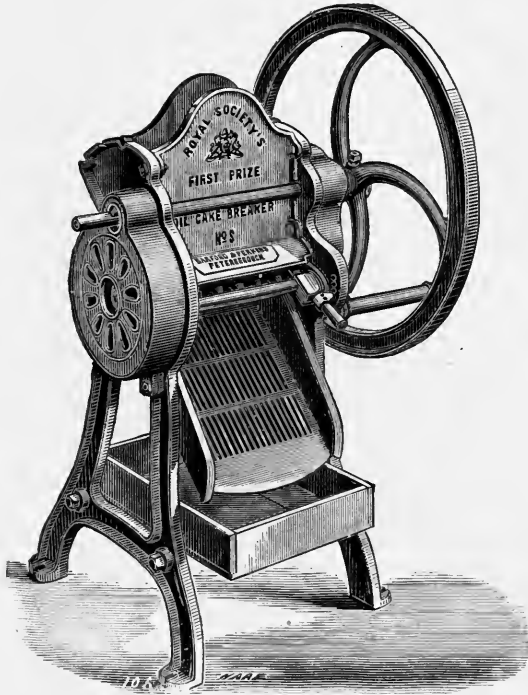


Fig. 361.—Barford & Perkins's Cake Breaker.

into manure of town and market refuse. Sheffield sends occasional contributions of mingled ashes, hampers, fish-bones, old boots, bottles, oyster shells, paper, vegetables, straw, and other 'jetsam' to this ogre's den at Heeley, all of which, after going (with a pinch of lime for the sake of sanitation) through the 'Devil's' maw, result in a digested mass of fertilizer, worth several pounds sterling per ton."

Messrs. Nicholson & Son's bone mill and disintegrator (fig. 360) consists of two pairs of toothed grinding rollers, one of coarse and one of finer pitch, set one above the other, an arrangement so well known in bone and cake mills as to need no further description. "The mill

is well and strongly made of the best materials and workmanship, while the roller adjustments, together with the provisions for allowing hard foreign substances to pass, are well considered and effective. The grinding rollers consist of separate discs of cast steel, which are interlocked one with the other for the purpose of diminishing galling of the square driving shaft, upon which the discs are loosely threaded." "It is," adds Mr. Pidgeon, "a remarkable sight to watch the toothed rollers crunching up huge horse heads and shoulder blades as if they relished the gruesome meal."

The general use of oil-cakes for feeding purposes renders it very necessary to employ a good cake-breaker, and in addition to the two large machines mentioned there are several smaller ones, fitted with one or more pairs of rollers. A single pair is sufficient for hand power, but when steam or horses are employed it is better to use two pairs, with

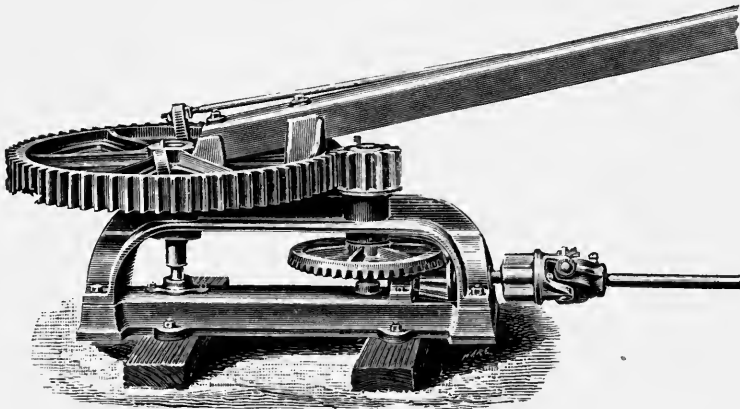


Fig. 362.—Hunt's Horse Gear.

the coarser pair above the finer. So long as animals can get the cake into their mouths, and swallow it, many feeders are satisfied, but considering how hard are the cakes now made, this is not sufficient. Large lumps are a relic of the old practice of breaking with a hammer, which made it too tedious work to break it down finely. If it is necessary to crack a bean, it must at least be necessary to break hard cake like the decorticated cotton-cake, which is often as hard, if not harder, down to the size of a bean.

The machine shown in fig. 361 is one of Messrs. Barford & Perkins's oil-cake breakers, suitable for working by hand. Larger machines are made with a double set of rollers, and fitted with a pulley for the driving band.

*Horse Gears.*—Notwithstanding the common use of steam as a motive power, horse gears are found very necessary for many of the minor operations on the farm, such as pumping, pulping, chaff-cutting, &c., where



only a small amount of work is required to be done at once, for which it would not be worth while getting up steam. Further, as horses may be economically used when other work is slack, the cost of steam is thus saved. In fig. 362 is shown one of the various sizes of horse gear which

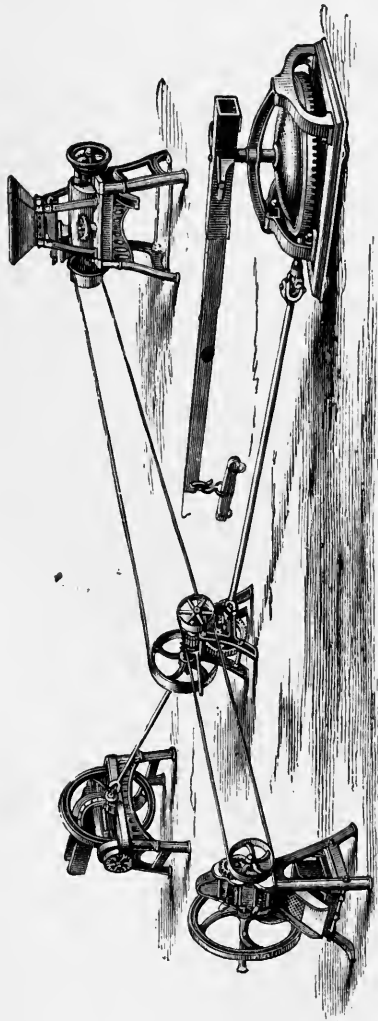


Fig. 363.—Barford & Perkins's Horse Gear for Working a Set of Implements.

Messrs. Hunt & Co., Earls Colne, Essex, supply. Other forms can be fitted with a separate intermediate motion for increasing the revolutions when greater speed is required, as in grinding, pulping, &c. This can be left out when the gear is used for working corn-stackers, pumps, &c.

These machines are made for working with from one to four horses. In fig. 363 we show how a set of Barford & Perkins's food-preparing machines can be worked by one gear; and in many cases this will be found most economical.

There is no better way of acquiring a knowledge of agricultural machinery than that afforded by a study of the progress of invention in this branch of constructive art. The further improvement of all classes of agricultural appliances is bound, moreover, to be stimulated by an acquaintance with what has been accomplished in the past. Hence, we feel that we are doing a service to the reader who is specially interested in the subjects that have been dealt with in this Book of "The Complete Grazier," by recommending to his perusal two papers written by the late Mr. Dan. Pidgeon, Assoc. Inst. C.E.—"The Development of Agricultural Machinery" ("Journal of the Royal Agricultural Society," vol. i., 3rd series, 1890); and "The Evolution of Agricultural Implements" (the same Journal, vol. iii., 3rd series, 1892). These articles give a good account of their subject up to the dates at which they were respectively written.

## BOOK THE NINTH.

### ON THE CULTURE AND MANAGEMENT OF GRASS LANDS.



#### CHAPTER I.

##### ON THE SIZE AND SHAPE OF FIELDS.

**I**N the expenditure connected with a farm, the items for fences usually constitute a prominent feature. There is no doubt that much unnecessary expense, and also much waste of land, are incurred by dividing the land into small enclosures; but farmers are too generally bound to maintain it as it was originally laid out. The extent of the fields should be regulated by the size of the farm, the nature of the soil, and the objects for which they are intended.

It has been remarked by a judicious writer, that "equal care should be taken to guard against the extremes of too much exposure, and a thick damp atmosphere; for the health, thrift, and beauty of animals are greatly promoted by proper shelter, and a due circulation of air."

Many examples are to be seen in Devonshire, "the land of small enclosures," where fully one half of the existing fences might in places be removed without unduly exposing the land or depriving it of shelter, and much land could thereby be added to the cultivated area. Numerous instances are noticeable in which adjoining fields, of 2 to 3 acres apiece, on the same farm, are under the same crop, and where the division fences could be spared without the slightest interference with the cropping, and without prejudice to the grazing of the seeds. As a case in point may be mentioned a farm near Totnes, upon which the total number of enclosures is 90. Of these, 13 are under one acre (mainly orchards), 14 others under two acres, 17 between two and four acres, 23 between four and six acres, and 23 between six and nine acres. The largest is 8a. 3r. 7p. The length of fences dividing these fields (exclusive of  $9\frac{1}{2}$  miles of boundary and road fences) is ten miles. The gates number 200, and as they cost, with their ironwork, 15s. apiece, to say nothing of the posts or pillars of masonry at each side, their erection and maintenance locks up capital which might be more usefully applied elsewhere.<sup>1</sup>

<sup>1</sup> See Mr. F. Punchard's articles in the Journal of the Royal Agricultural Society, 1890.

But, while the stagnation of the air in confined situations may have an injurious effect on vegetable as well as on animal life, the too free exposure to the wind is not less objectionable, especially where the elevation is considerable, as in mountainous and hilly farms. This is sometimes demonstrated in the luxuriance of that part of the herbage which is sheltered by the fence, and in the poverty and even the barrenness of the centre of the fields. In such situations, therefore, the hedges should be so planted as best to break the force of the winds to which the land is most exposed. "It is as much," says the writer we have just quoted, "on account of the shelter, shade, and equal warmth, as of occasional fresh supplies of grass, that the Leicester graziers have founded their opinion, that *fifty acres in five enclosures, are equal to sixty in one.*"

Whatever be the dimensions adopted for the enclosures, the convenience of access to water must always be a prime consideration, especially in enclosures where live stock are at any time to be kept. The method of drainage, the position of the ground, and the bringing together, as far as is practicable, of lands of similar quality, or that can be cultivated or stocked under like circumstances—even though this may tend to render the enclosures in some degree unequal in size and irregular in form—are all objects of importance. Where, however, there are no circumstances to prevent the enclosures being formed in a regular manner, principal regard should be paid to the size of the farms and to the course of cropping that can be most beneficially practised on them. In such cases, they should be laid out to suit the nature and extent of the farm, the system of cultivation, and the mode of carrying off its products.

In the primary division of the farm, regard should be paid to the rotations of crops which its soil or other circumstances will probably render desirable, and, if possible, *two enclosures should be allotted to each division of rotation.* This is the principal consideration with regard to moderate-sized farms, both in grain crops and in pasture. In the former, one field may be devoted to potatoes to be followed by wheat, and another to turnips succeeded by barley; whilst, on grass land, the shifting of the pasture, so beneficial to every kind of stock, can be more easily effected.

With regard to the *shape* of fields, although this must be in some degree determined according as the surface of the land is hilly or otherwise, as well as by the position of roads, and many other local circumstances, it is evident that for ploughed ground it is most advantageous to have the fences in straight lines, and that the fields, when large, should be rectangular, and when small, of an oblong rectangular form, in order that the ploughing may be effected with as few turnings as possible. Irregular-shaped fields often cause much annoyance, and lead to waste of both time and land in their tillage.

In the laying out of pasture land, the material object should be shelter from the most prevalent and piercing winds. When, in the laying out of a farm, it is necessary to have some of the fields of an oblong shape, it is desirable that the longer direction should run, as

nearly as possible, north and south, for the ploughing will then be usually performed in that direction, and the sun's rays will have freer access to both sides of the furrows, not only before sowing but also during the growth of crops, both of which are circumstances of considerable importance. Another convenience in arranging the fields to run as much as possible north and south is that the cattle have greater shelter from the east and west winds, which in Britain are the most frequent.

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## CHAPTER II.

### ON FENCES.

THE nature and construction of fences vary considerably in different districts, according to circumstances of situation and convenience, and, in many instances, according to some absurd custom of the country. They are constructed on the principle of affording protection from too much cold, and at the same time of preserving a proper circulation of air. On these two factors depend the health of live stock and the well-doing of crops. Fences may be classed under the heads of banks, ditches, walls, hedges, wire fencing, iron fencing, and gates.

I. EARTH BANKS are chiefly employed in those localities where other materials for constructing fences are difficult to procure. They will be found in most of our hilly or upland districts; and they are not only durable but useful and cheap, especially if the turf can be obtained from any surface immediately adjoining. The following is the ordinary method of forming earth banks:—

The line of the fence being fixed upon, the turf should be pared off, about 4 or 5 inches in thickness, from the farther edge of the future ditch on one side to that on the other, regard being had as far as possible to what was stated at the close of the last chapter respecting the direction in which the hedge should run. The level of the ground should likewise be considered, in order that the ditches may act as useful and efficient drains. The turf being piled on the sides, the earth which is dug out from the ditches should be piled on the centre space between them, in a somewhat sloping direction, and well and firmly beaten down. The ditches if about 2 feet deep, will furnish sufficient earth to make the bank 4 feet high. "Great care must be taken," says an eminent foreign agriculturist, "in cutting the turfs with which the bank is to be covered, especially where they are thick. They must be cut in a direction oblique to their surface, so

that when placed upon the surface they may fit into each other exactly, and the lower edge of each turf adjust itself above the upper edge of the one below it. The operation of covering or turving the bank must, of necessity, be commenced from the bottom; and it is of importance that the first row of turfs should be of the same width throughout, and also that all the individual pieces of which it is composed should be of a uniform breadth. When the first row is completed, another may be placed above it, care being taken to adjust the turfs together with all possible exactitude, so that they may join evenly, with the lower edge of one row slightly overlapping the upper edge of that beneath it. Before the turfs are put on, the earth should be well beaten, and the surface rendered as even and free from hollows as possible." The slope should be so contrived that the top of the bank shall be about  $2\frac{1}{2}$  feet wide; it is planted with hawthorn, or with any of the other shrubs useful for fencing. These earthen banks should be raised in moist, or even in rainy weather, as the turf will then be most likely to adhere and to grow. When they are made in dry weather, and much rain falls soon afterwards, there is danger that the soil between the sods will swell, and by bulging outwards materially affect, if not totally destroy, the solidity as well as the symmetry of the bank.

II. DITCHES are cut to serve either as drains, or as fences, or to answer both purposes. Those which are made or repaired at the feet of banks on which quickset hedges are raised, should seldom be less than 3 feet wide at the top, by  $2\frac{1}{2}$  feet in depth, and 9 inches wide at bottom, in the driest soils; but in all wet or moist situations they should be both wider and deeper. Thus each side acquires a slope, which is an indispensable necessity; for when ditches are cut perpendicularly the sides are continually washing down. Whatever be their purpose, whether for draining or fencing, ditches ought to be so constructed that the water they contain may never become stagnant, but run off into some adjoining rivulet or brook. They should likewise be regularly cleaned out every year.

III. WALLS are a very useful kind of fence in districts where stones can readily be obtained. When well constructed they are of great durability. Although not so ornamental as hedges, they are in every way preferable in point of utility, for they require no nursing, or cleaning, or pruning; and are not so easily destroyed by the trespassing of various animals. The benefit is immediate; they provide excellent shelter, they occupy little space, and afford neither a harbour for ground vermin nor a nurture for weeds, though they sometimes harbour insects. They make no demand upon the soil, and, if a gap be made, the material is at hand for re-building.

Limestone, ragstone, gritstone, or any other kind of stone that is convenient, may be used for the purpose; but limestone and gritstone are preferable, on account of their being most easily prepared. Walls are made either with stones only, in which case they are termed *dry stone walls*; or with stones and earth intermixed, when they are termed

*earth and stone walls* ; or with lime and sand, in which form they are denominated *mortared walls*.

In constructing mortared stone walls, the foundation should be about  $2\frac{1}{2}$  feet in width, and the wall should taper upwards to a width of 10 inches or 1 foot. The foundation should be placed at a sufficient depth in the ground to be below the reach of frost, and the wall should be carried up to the height of 6 feet, and coped at the top with stones placed edgewise.

Where lime cannot be procured to cement the stones, a dry wall may be constructed in the same manner, and, if judiciously arranged, this dry masonry will last nearly as long. The foundation should be laid on firm ground or on greensward, or, if this is impracticable, the loose earth should be dug away until some solid base is obtained. The



Fig. 364.—Mode of Building Stone Wall.

largest and flattest stones should be placed at the bottom, and, at frequent intervals, stones should be introduced of sufficient size to reach from one side of the wall to the other. The large and small stones should be uniformly mixed throughout the wall, so that in every part of it they may break bond as much as possible. A wall,  $2\frac{1}{2}$  feet thick at the base, half as wide at the top, and about  $4\frac{1}{2}$  or 5 feet high, will answer every useful purpose. On hilly ground, however, where intended as a fence against sheep, and where shelter is much needed, the wall should be 5 or 6 feet high ; for a height of 5 feet the breadth should be 27 inches at the base and 14 inches at the top. On the top of the wall, but included in its aggregate height, should be placed a row of upright stones, fitting together with tolerable accuracy, and called "coping stones." Such a wall is best built by two men working together on opposite sides, and using a wooden frame as a guide (fig. 364).

IV. HEDGES.—The plants which have been chiefly used for hedges are the following :—

1. The WHITE-THORN, or HAWTHORN, or QUICK (*Cratægus oxyacantha*, nat. ord. Rosaceæ), which grows very rapidly, is durable, will flourish in almost any situation, excepting on very thin soils, and is, perhaps, better adapted, in every respect, for the formation of a compact and serviceable fence than any of the other plants commonly employed. The thorns should be raised in a nursery, and transplanted, when a year old, into some open piece of ground where the soil and space admit of the free development of the roots and branches; a poor soil should be chosen. Here they may be kept from one to two, or even three years, before being set in the hedges; and then they will fully repay the care that has been bestowed upon them. The different varieties of the hawthorn are very interesting on account of their ornamental appearance, especially when laden with their fragrant white or pink "May" blossoms, or their brightly-coloured fruit, the "stony haws."

2. The BLACK-THORN, or SLOE (*Prunus spinosa*, nat. ord. Rosaceæ), should be placed next, so far at least as strength and hardihood are concerned, but it is difficult to keep this shrub within proper bounds. Its growth is less certain than that of the white-thorn, but its bushes, being compact, are superior for mending dead hedges, and are less liable to be cropped by cattle.

3. The HOLLY (*Ilex Aquifolium*, nat. ord. Aquifoliaceæ), though slow and less certain in growth, forms a hedge which, by its thickness and strength, and the excellent shelter it affords, compensates for the delay and expense involved. The holly constitutes a beautiful feature in the winter scenery of many parts of England. Its dead leaves, however, are rather troublesome when they fall among the grass.

The best mode of making hedges with holly is, first, to mark out the line of ground, and prepare it by ploughing or digging; the young plants, having been carefully lifted, so as not to hurt or injure their roots, are then placed in the ground, four or five quick or white thorns being planted to one holly. As the hollies increase in size, the thorns may be pulled up, and when the former have attained their full growth they will occupy the whole space, and form a most durable fence. Should any intervals occur, they may be easily filled up, by bending down the lower branches ("layering"), and covering them with earth. In the following year these will take root, and shoot forth so as to present an impenetrable barrier.

White-thorns do not flourish on some thin and gravelly soils; and there is often a considerable failure of them in an ill-constructed hedge. Where the centre of the bank has not been sufficiently manured or prepared, or where the thorns are planted so much on its slope as to receive little benefit from the rain which runs down the bank into the ditch, failure generally results. In the first construction of the hedge, a flat bed, 3 feet broad and well manured, should be left on the top, and in the middle of this the quicks are planted.



*Quicks*, or cuttings from the hawthorn, thus planted, will find much nutriment in the soil before the tap-roots reach the barren, gravelly bottom; and the earth thrown up from the ditches will retain enough moisture to nourish the plants, which will in ten or twelve years form an excellent fence.

As thorn or quickset hedges are admired both for their beauty and their utility, the following account of their culture and management, in Northamptonshire, may appropriately be added:—

“The largest haws, being gathered in the autumn from the finest and healthiest growing thorns, to the amount of one, two, or three bushels, according to the quantity which may be wanted, are first put in pits or holes, to clear them from the pulp, and in the spring are sown, not too thick, in beds duly prepared as if for onions, about the breadth of asparagus beds, with paths between, for convenience of weeding, etc. Sift over these a quantity of fine earth, sufficient to cover them uniformly about half an inch. Take care to keep them very free from weeds throughout the summer; and the next or following spring, according to their size, thin and transplant them into rows in narrow trenches across similar beds, the rows being about three or four inches distant, according to the strength of the plants, to remain till the following spring. Keeping them clear of weeds in every stage is of the most essential importance, as it not only expedites their growth, but prevents mildew, to which they are very liable in damp, foggy weather, and unfavourable seasons. If the mildew affects them in the spring quarter, they will often revive at midsummer; but afterwards, it commonly stops them for the rest of the year.

“About the latter end of March, or early in April, draw out the best of the young plants, from one-eighth to one-fourth of an inch in thickness, which will sooner take root than larger ones, and form them into bundles of 1,000 each, the ground being first prepared for planting them by cutting out a small trench, not deeper than the good soil, on each side of the proposed fence-row, and throwing over it turf, on which the plants are to be deposited. Hollow it out in the form of a basin or punch-bowl, the outer side of which, where the plants are to be fixed, should be rather higher than the inner side, and sloping off by a line of equal height from the bottom of the hollow into the fresh earth which is thrown up, to form a bed for the plants. Having first cut off the small end of the plants, so as to leave only two or three buds above the ground when planted, or at the utmost about 3 inches, cut off also as much of the root end as to have only 4 or 5 inches in the ground, when covered with earth, taking care to leave on some of the tender fibres of the root, slightly trimming the fine ends with a sharp knife. These may be placed about 3 inches asunder, a little more or less, according to the strength of the plants, so that 12 of these will extend a yard, and 264 a chain, or what they call for that purpose only, an acre. Having covered a sufficient length of these, and the side inclining as before, another line is to be sloped off, about 3 or 4 inches above the other, in which another row of plants is to be deposited in the same way, and at the same distances, covered with

earth as before, care being taken to place each plant in this upper row against the intervening spaces of the plants in the lower row. This row will, therefore, contain as many plants as the other; and both of them together about 528 plants in a chain of 22 yards in length. Then finish off the inclination of the sides, with a small flat or hollow on the top above the upper row; and so proceed until the whole is finished. The sooner the plants are thus deposited in their new situations, after removal from the seed-beds or nursery-beds, the better; but especially be careful to put them in speedily after cutting and trimming, before the sap dries up; and no time should be lost in laying them in their places, whilst the natural moisture continues in the soil from the trenches, both for bedding and covering them."

The hollow or basin form of disposing the ground for planting the sets is an important consideration on dry soils, although in many instances not observed. If the weather should prove dry, it serves as a reservoir for collecting every particle of moisture that falls in the space between its extreme edges. This goes to supply the roots of the plants that are just above it, and that will soon strike down towards it. The weeds, which will naturally push forward, must be kept under by hand-hoeing and weeding, both above and below the rows of plants, as well as between them. The operations of hoeing and weeding are performed four times every summer. Early in the spring, before the hay-harvest, and before and after the corn-harvest, are the usual seasons of performing these operations.

All this trouble and expense would be of little use, if no care were afterwards taken to preserve the young hedges from the injuries arising from the bite and tread of animals. It is customary, therefore, to have rough posts and rails on each side of the bank, which form a secure fence against large cattle; these posts being placed at such a distance from the hedge on each side, that the cattle cannot reach over to crop the plants.

Where any plants have accidentally failed, they should be replaced on the first spring-hoeing by fresh sets. In two years, or three at most, where this care has been taken, and the soil is not too poor, the plants will have gained sufficient strength to permit of their being cut down to about 7 or 8 inches high, which will cause them to throw out numerous strong and thick shoots; so that, in two or three years more they will constitute a fence sufficiently strong for confining sheep in the field, though it may be several years before the fence would be considered safe against cattle. The richness of the soil, and the attention paid to the hedge, alike influence the growth of the latter. Before this time the posts will have begun to decay at the base, and will need to be occasionally repaired and guarded; but ordinary attention will always obviate any serious injury.

The *management of a quickset hedge* requires both skill and attention. During its first season it must be kept scrupulously clean, great care being required to check the growth of weeds, which prevent the formation of lateral branches. If the growth is strong a few of the straggling side branches may be cut off in the second year, but this is not of much im-

portance except for the sake of appearance at the time. In the third year, if there has been a fair growth, the whole hedge should be cut down, as above recommended, to within 6 or 8 inches of the ground, so as to form in the future a dense bushy bottom growth. Though the hedge must at all times be kept clear of weeds, yet in this and the following years it is particularly important to give the side shoots a full chance of growing. The cutting of the hedge should be done in the autumn, and, as on all occasions when cutting hedgerows, the strokes should be made *upwards* and not downwards, for the wood is cut cleanly so, whereas, when it is cut down it is apt to split. The best shape for a hedge is  $\Lambda$ , for the strength is required more at the base than the top. Neglected hedges too often take the form of  $V$ , and soon become gappy and unreliable. Hedges require cutting at least once a year, and this is generally looked upon as autumn work, though those who desire to have their fences particularly neat have them lightly swished in July, when the weeds are cleared out. In course of time they become weak at the bottom, and when this is the case one of the two rows of thorn should be cut down to within a few inches of the ground so that a growth of fresh wood may be obtained at the base. When this side has made good growth the other row may be treated in a similar manner. By such means the whole hedge becomes again formed of young wood. As old hedges become gappy, the small gaps may be stopped by laying down young shoots in them, but if the fence is very weak it should be allowed to run up for a few years in order to grow long sticks or boughs for layering, so as to form a live wattle hedge.

When laying a hedge it is better to have live stakes than to have to insert dead ones around which the layers may be wattled, for the former are much stronger and more durable. Inexperienced hedgers are liable to commit the error of leaving too much wood, as their idea is to make a fence at once; whereas a laid hedge should *grow* into a fence. When much wood is wattled into a hedge it becomes smothered by the new shoots and dies for want of air. The middle or heart of the hedge thus becomes rotten, and permanent injury is done. The thorns which have been cut shoot out and quickly grow into a fence, strengthening that which has been wattled, and in a year or two a better fence is grown than when it has been wattled in too thickly. On all occasions where possible the use of dead wood should be avoided, as it tends to choke and destroy the hedge, but if there is not sufficient growing wood to make the fence secure it is economical to put in rough posts and rails, which do not hinder the growth of young wood. A newly laid hedge requires binding on the top to keep the layers in position; this is effected by means of "edders" or "headings," which are thin poles wattled and twisted round the stakes in such a manner that cattle cannot throw them off. When cutting hedges it is preferable to use a long hedging bill, worked with an upward swing, than to clip them with shears.

In addition to the plants already recommended for the construction of fences, may be noticed the HORNBEAM tree (*Carpinus Betulus*, nat.

ord. Cupuliferæ), which is largely used on the Continent. It is propagated from slips or sets, and thrives admirably on poor, barren, and exposed lands. When well pruned and carefully tended it forms a compact green fence; otherwise, it is apt to run to wood.

On dry sandy situations, **FURZE**, or **GORSE**, or **WHIN** (*Ulex Europæus*, nat. ord. Leguminosæ), may be made use of, and with advantage, if planted at a proper time, and managed with care. For this purpose a bank should be raised about 4 feet in height, 5 or 6 feet broad at the bottom, and 18 inches wide at the top, with a shallow ditch on each side, the upper surface of which is to be thickly sown with furze seeds in March or April. The seedlings will grow vigorously, and in the course of two or three seasons will form a fence that will continue for several years, requiring no rails after the first year or two, and being impenetrable to the larger animals. As, however, the furze increases in size, the older prickles will decay, and consequently leave the lower parts of the stems exposed. This inconvenience can only be remedied, or partially prevented, by supplying the bank with new plants, which should not be permitted to shoot up to such a height as to leave the lower parts naked. If one side of the hedge is cut down close to the bank, the other half will continue as a fence, until the former part attains a proper size, when the opposite side may be cut down in a similar manner; so that the bank will continue for many years to have a strong hedge upon it, without being liable to become bare at the roots.

Other plants occasionally used for making hedges include the **PRIVET** (*Ligustrum vulgare*, nat. ord. Oleaceæ), the **HAZEL** (*Corylus Avellana*, nat. ord. Cupuliferæ), the **BEECH** (*Fagus sylvatica*, nat. ord. Cupuliferæ), the **BIRCH** (*Betula alba*, nat. ord. Betulaceæ), the narrow-leaved English **ELM** (*Ulmus campestris*, nat. ord. Ulmaceæ), and **WILLOWS** (*Salix* sp., nat. ord. Salicaceæ). Hedges are sometimes formed of several species of hedge-shrubs, mingled together. None of the plants just enumerated are of any special value for field fences, and are only to be recommended in exceptional circumstances.<sup>1</sup>

V. **WIRE FENCING** has been adopted to a great extent during the last few years, and, as better material is being introduced, it is highly probable that its use will continue to increase. In the colonies where labour is dear, and other material difficult to obtain, it makes by far the most useful and economical fence. Barbed wire has more recently been introduced, and in most cases with good results. The chief objection to its use in England is the danger it causes in the hunting field, but, in the face of curtailed profits, farmers are compelled to resort to the cheapest material for making and mending their fences. As most makers now adapt their standards so that the strands of wire can be easily unhitched, the wire difficulty in hunting countries may be settled by making an arrangement with the farmers to take down the top strand as soon as the cattle are out of the field, and not to replace it until the hunting season ends, which is about at the same time of year

<sup>1</sup> See "Hedges and Hedge-making," by W. J. Malden, in *Journal of the Royal Agricultural Society*, 3rd series, vol. x., 1899, p. 87. Reprinted as a pamphlet (32 pages), price 6d.

as cattle are usually turned out. Another objection to the use of barbed wire is that it is liable to cause injury to stock, but the damage done by the wire is probably not greater than that caused by some of the more popular methods of fencing,—for instance, staking by hedges, and drowning or straining in ditches. Sir Walter Gilbey used it round his horse paddocks, containing many valuable animals, without any accident for a number of years. Though wire makes a fence against animals, the advantage of shelter afforded by hedges and walls is lost. It may be used to fence against all kinds of animals, as wire of any strength, and standards of any required height, are made by several firms. Either iron or wood standards can be used.

Messrs. Bayliss, Jones & Bayliss, of Wolverhampton, have paid special attention to the manufacture of wire fencing, and fig. 365 affords illustrations of their most approved forms of standard. No. 5

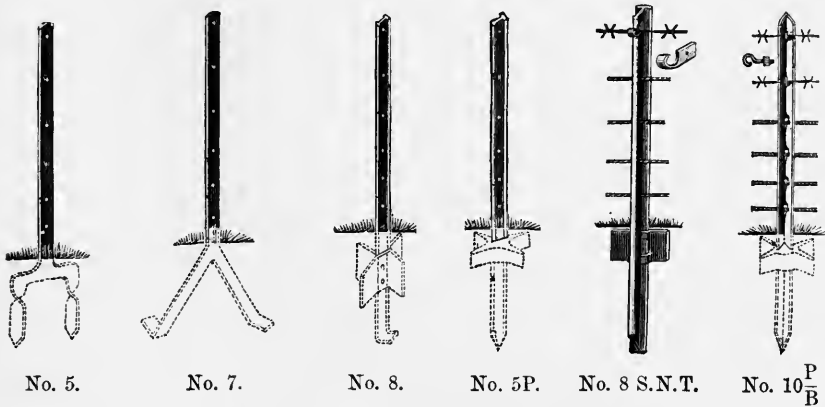


Fig. 365.—Standards for Wire Fencing.

is of wrought iron, with double-pronged foot, 3 feet 9 inches above ground. No. 7 is of wrought iron, with angular foot, 3 feet 9 inches above ground. No. 8 is of wrought iron, made in one piece without any weld, and with wrought-iron plates rivetted on, 3 feet 6 inches above ground. No. 5P is of girder iron, same section as No. 8, fitted with cast-iron wing earth-plate, instead of plates rivetted on. No. 8 S.N.T. is a bulb tee steel standard, 4 feet above ground, with malleable clip for top barb wire only; the lower holes are punched for threading plain wire in the ordinary manner. No. 10  $\frac{P}{B}$  is made of angle iron, 3 feet 9 inches above ground, and is fitted with malleable clips throughout. All of these standards can be fitted to carry any number of wires required.

Fig. 366 represents the method of setting up an ordinary fence, and illustrates the manner of fixing the straining post, and the adjustment of the dropper (which does not enter the ground, but retains the wires in their proper position). It also shows the working of the clip, a

simple method of attachment which greatly facilitates the setting up of the fence. There are many convenient fittings for fixing wire to wooden posts, such as staples, straining eye-bolts, &c., which need not be illustrated here, but can be seen in the catalogues of makers.

VI. IRON FENCING.—Very substantial and durable fencing is made with iron. The first cost is heavy, but as iron fences take up very little room, harbour no weeds, are suitable for parks as not obstructing the

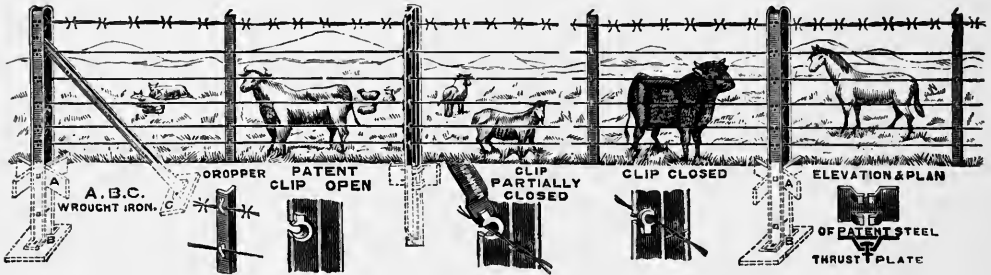


Fig. 366.—Wire Fencing with "National" Steel Standards.

view, can be relied upon to enclose animals, cost nothing for repair beyond an occasional outlay in paint, and are practically permanent, they are not expensive in the long run. Their greater cost renders them less popular than some other fences where tenancies are short,

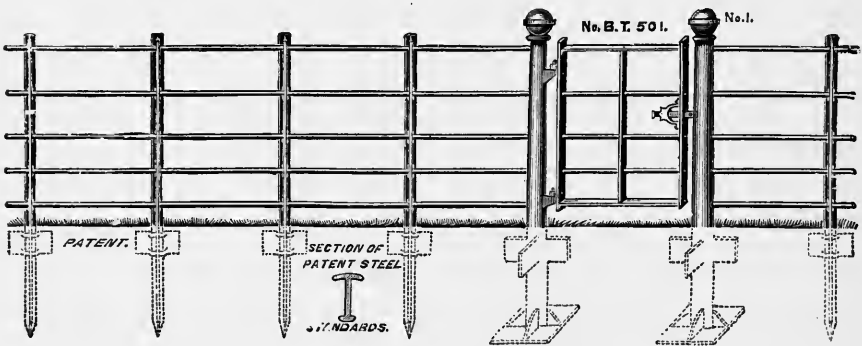


Fig. 367.—Continuous Iron Bar Fencing.

and their use is chiefly restricted to private parts of estates, and to farms held on long leases. Iron fencing can be obtained in the form of separate hurdles from 6 feet to 10 feet in length, or as continuous fencing. Fig. 367 shows an above-ground and underground section of continuous bar fencing, with bulb tee steel standards, and round steel tubes. The terminal pillars are of cast iron, with self-fixing bases, as made by Messrs. Bayliss, Jones & Bayliss.

VII. GATES are of various kinds and denominations, according to the form and materials of which they are constructed.<sup>1</sup> The principle, in all of them, is to combine strength with lightness and cheapness. The kinds of wood usually employed for this object are oak, larch, beech, and other solid timber; though the Dutch willow, and some lighter varieties, may be usefully applied to the same purpose. When putting up gates, the chief points demanding attention are, the *fixing* of the post, so that it may resist the shocks that often accompany the forcible swinging of the gate, and the *hanging* of the gate itself, in order that it may shut easily and truly, without dragging on the ground.

With regard to the gate-post, where timber is used, it should be that of the oak or the larch, and that part which is to be buried in the earth should be prepared either by tar or pitch, or by charring, or, better still, by creosoting. Respecting this last-named process, Messrs. Armstrong, Addison & Co., Sunderland, state that after over twenty years' experience, they are satisfied that large-sized timber cannot be thoroughly preserved with less than two-thirds of a gallon of creosote oil to the cubic foot, and, in smaller scantlings, where there is a great deal of surface, their rule is to inject fully one gallon to every cubic foot of wood. Care is taken that the timber is in a fit condition to undergo the process, and further, that the creosote oil used is of the best quality for the purpose. They add that the timber should not be cut after being preserved. The denser and more valuable portion of the preservative is near the surface, and this should not be disturbed if it can be avoided.

Such preserved posts should always be firmly and deeply fixed, about four feet being let into the ground. All the upper part, that which is exposed to the air, should be covered with one or two coatings of oil-paint, which will be attended with comparatively little expense, while the advantage thence derived, in point of durability, is very considerable. Gate-posts are more durable if their *natural position is reversed*, that is, if their top is buried in the soil, and that part which was nearest to the root is out of the ground. No reason has hitherto been assigned to satisfactorily account for this fact; but it cannot be too extensively known where timber is used for gate-posts. Larch fir posts should have the bark stripped off, as it harbours insects and moisture. It is curious that, contrary to what is usually the case, the sap-wood of larch fir is heavier, tougher, and stronger than the heart-wood, and usually lasts longer. Stone gate-posts, however, are always preferable to wood, where they can be obtained, unless the stone be too brittle. Iron is often used for ornamental gates, and some forms are very elegant, lasting a long time if painted yearly.

In his paper on "Estate Fencing" (see "Transactions of the Surveyors' Institution," 1890—91), Mr. Arthur Vernon gives the following approximate estimates as to the durability of fences:—

Small fir fencing in the round with the bark on, 12 or 15 years.

<sup>1</sup> An instructive paper on "Field Gates" appeared in the Journal of the Royal Agricultural Society, 3rd series, vol. iv., 1893, p. 37.

Larger and hearty fir fencing, 15 to 20 years.

Oak posts and split oak fencing, 40 to 50 years.

Iron fencing, unknown, but probably unlimited, well painted or coated with some indestructible material, every 3 years.

Thorn hedges, 100 years and upwards.

Stone and brick walling, when kept in repair and protected from the weather by a good coping, unlimited.

He further quotes the subjoined summary of description and cost of fences on an English estate :—

Description.	Cost per Yard. <sup>1</sup>	Estimated Annual Cost for Maintenance per 100 yards in length.	Estimated durability, in years, in good order.	Observations.
FENCES.				
Haw Haw . . . . .	24/-	1 0 0	Unlimited	
Walling (averaging 8 ft. high) . . . . .	30/-	1 5 0	Unlimited	{ Will need pointing and repair, say, once every 20 years.
Dwarf walling and iron fence . . . . .	15/-	1 10 0	100	Iron liable to fracture.
Oak pale fencing (close pallsading) 6 ft. high . . . . .	9/-	0 15 0	40	{ Will need occasional repair and renewal of gravel plank during term, also spurring posts.
Do., 4 ft. high, on bank . . . . .	7/6	0 10 0	40	Ditto.
Do. (open pallsade fence) . . . . .	6/6	0 10 0	30	
4 ft. strong continuous iron fencing, seven bars . . . . .	3/-	0 11 0	60	{ The most durable of iron fences.
Wire fencing, seven wires and iron posts . . . . .	2/-	0 5 6	40	{ Will need yearly attention and occasional straining up.
Thorn hedge with ditch . . . . .	-/6	0 1 6	{ 100 years and upwards	{ See notes in Paper.
Posts and 3-rails larch fir fences (oak posts) . . . . .	-/9	...	20	{ Will usually last until hedge well established
Do. (with fir posts) . . . . .	-/6	...	15	Ditto.
4-barbed wires and iron uprights . . . . .	1/6	0 2 6	30	{ Needs special attention as it becomes dangerous if broken or loose anywhere.
GATES.				
Oak field gates (painted) . . . . .	{ Each } 15/-	{ ... }	15 to 20	{ Durability varies much with position and use.
Oak do., posts 8 in. by 8 in. and 7 in. by 7 in. (iron work and fixing) . . . . .	{ Per } Pair } 28/-	{ ... }	25 to 30	Ditto.
Iron entrance gates . . . . .	{ Each } £5	{ 0 2 6 }	Unlimited	{ Should be painted every 4 years.
Do. . . . .	£100	1 0 0	Do.	Ditto.
Iron gates to garden . . . . .	£7 10s.	0 10 0	Do.	Ditto.
Iron hand gates . . . . .	£3 10s.	0 5 0	Do.	Ditto.

<sup>1</sup> Possibly some of these prices would not hold good at the present time.



## CHAPTER III.

## ON PASTURE LAND.

MUCH confusion has arisen, and points of controversy have been needlessly multiplied, through the indiscriminate use of the terms pasture and meadow. Such might be avoided by restricting the term *pasture* to grass lands that are invariably grazed and never mown. The term *meadow* might then be applied to grass lands that are regularly mown, that is,—to those which are periodically utilised as hayfields. It is true that the latter, also, are usually grazed at some period of the year, so that it would appear to be preferable to define as *pasture* such grass land as is grazed but never mown, and to regard all other kinds of grass land as *meadow*. The right thing is to look upon grazing lands as pastures, and hayfields as meadows.

The necessity of some distinction may be shown by an example. Let two adjacent pieces of land, as closely similar in soil, situation, aspect, previous treatment, &c., as is possible, be laid down to grass with the same mixture of seeds; further, let the one area be mown every year, and let the other be grazed but never mown. It will be found that the herbage on the two areas will come to differ markedly, both as regards the species of plants and their relative abundance. Or, let a field of grass, that has been constantly pastured and never mown, be divided into two parts by a fence, and let the one part be henceforth treated as a meadow—that is, mown every year—whilst the other part continues to be grazed. In time, the herbage on the two portions, hitherto identical, will come to differ widely. In the meadowed grass land, such species as *Dactylis glomerata* (cocksfoot) and *Holcus lanatus* (Yorkshire fog) become predominant; in the pastured grassland, rye-grass, which recedes under the scythe, comes to the front and takes up its position as one of the leading species in pastures.

The excellence of pasture land depends greatly upon its situation, and must be estimated with reference to the different classes of animals for whose use it is intended. Thus *uplands*, or high hills, will only suit stock of peculiar kinds, while lands of less elevation, though still hilly, will be found profitable for feeding sheep; and on those which are still lower and more enclosed, neat cattle may be fattened to the greatest advantage. It is generally found that the older pastures are best calculated for the feeding of fattening stock, while the new leys are more adapted for feeding young store cattle. It may also be added,

that the size or extent of the enclosure influences the use and value of pastures.

On damp soils a dressing of one cwt. nitrate of soda, two cwt. superphosphate of lime, and three cwt. kainit may prove very beneficial in sweetening the grass and increasing its growth. Indeed, superphosphate alone will generally effect a marked improvement.

Basic slag in dressings of five to ten cwts. per acre is of great value for grass land, especially on clay soils poor in lime, on which it encourages the growth of clover. On soils containing a sufficiency of lime, liberal applications of superphosphate have a like effect. If the soil in either case be poor in potash, kainit or sulphate of potash materially assists. Slag should be applied in the autumn to show its full effect in the following season.

Grass land, whether meadow or pasture, may be well chain-harrowed and rolled, during the latter part of winter and early spring, in order to distribute dung and destroy moss. It is almost impossible to work such land too much provided it is not done during frost. Harrowing and rolling are practically the only kinds of tillage grass land receives, though much grass land has little or no need of such treatment.

In the southern counties pastures are fit for stocking from the latter part of March to the commencement of May, according to their situation and the nature of the soil; but in such as are situated farther north, the turning of cattle into the pasture may be delayed till the middle of May, or even longer, with considerable advantage. All pastures are rendered sweeter by being eaten off tolerably bare at least once a year.

One of the most efficient means of regenerating poor pastures is draining. Harrowing, too, has an excellent effect on hide-bound or mossy land, but without additional manuring the moss soon re-appears. Applications of clay benefit sandy and peaty soils; composts, liquid manures, wood ashes, soot, bones, superphosphate, potash salts, basic slag, salt, nitrate of soda, guano, chalk, and lime, are all excellent as top-dressings for different soils. Numerous experiments have proved that the judicious use of artificial manures renders the application of farmyard manure to grass lands unnecessary, unless at wide intervals. The latter, as a rule, is more needed on arable land.

Marked irregularities arise in pastures owing to the too common practice of allowing the droppings of horses and cattle to lie undisturbed upon the land. They should be spread frequently.

A source of injury to pastures, Mr Martin J. Sutton points out,<sup>1</sup> may arise from the manner in which grazing is conducted. "It is obvious that land can never be enriched by the droppings of cattle fed exclusively upon its herbage, but, on the contrary, must by degrees become the poorer for supporting the life and increasing the weight of the animals which graze it. In milk and flesh the land yields its

<sup>1</sup> "Permanent and Temporary Pastures, with Descriptions and Coloured Illustrations of Leading Natural Grasses and Clovers." By Martin J. Sutton, Chevalier de la Légion d'Honneur, &c. Fourth edition. London: Simpkin, Marshall, & Co., 1891. We are indebted to the Author for permission to make numerous quotations from this work.

produce in highly concentrated forms, and without external aid the process of exhaustion must of necessity go on. But when the herbage consumed is supplemented with cake, corn, roots, hay, or other extraneous food, the tide is turned, and benefit is conferred on the pasture in addition to the advantage which the animals derive from it. In this extra feeding of grazing animals there is a simple and economical means of enriching a poor pasture, and the increased weight of the stock affords an immediate and sometimes a complete return of the outlay. The economical side of this practice deserves a further word. The moving and carting of heavy bulks of manure is avoided, and the land at once has the benefit of the droppings. When manure is stacked in heaps, or is allowed to lie in the farm-yard, some of its most valuable constituents drain away or are dissipated in the atmosphere. The common practice of grazing a pasture by day and folding on the arable land at night is a frequent means of impoverishing grass land. Even when the sheep are helped with cake it is no sufficient compensation for their absence during twelve out of the twenty-four hours, especially the twelve hours of night.

“A further means of deteriorating grass land is the practice of allowing pastures reserved especially for horned cattle to be overstocked. When an ox-pasture is eaten down so bare as to allow the roots of the more succulent grasses to become scorched, it is a serious injury not only for that year's feed but for that of several subsequent seasons. On the other hand, it has already been stated, that a sheep pasture cannot easily be cropped too close to maintain constant growth of the sweet fine herbage of which it should consist.

“There is widespread indifference as to the predominance of such weeds as cowslips, primroses, orchids, daisies, and plantains. The presence of these weeds and of barley grasses and brome grasses is an evil in itself, and they indicate that the land is starved, just as hair grass, rushes, and sedges prove the need of drainage. Thistles, docks, coltsfoot, and other large weeds may also abound, and they cannot be eradicated without the constant use of the scythe and spud. In a foul pasture the weeds are generally so mixed up with what good herbage there may be, that they can only be improved out of existence as better grasses are induced to take their places. A heavy dressing of salt applied after weeds have been cut will kill a lot of them, and an application of gas-lime has been known to effect a surprising change in the herbage of an inferior pasture. The folding of sheep thickly will also produce marked benefit on poor upland grass if the animals are at the same time fed with corn or cake. They should be penned or folded on the ground long enough to clear the crop, and then many weeds will be killed outright. This practice is very different in its effects from that of giving sheep the run of the land. Whatever discourages the growth of rough herbage encourages that which is better. On the other hand, however good a pasture may be, it has only to be persistently neglected, and in time it will revert to the waste condition of a moorland.

“A succession of wet summers is another fruitful source of injury to

pastures. The bulk of herbage forced from them during warm damp seasons tends greatly to their impoverishment, and some of the grasses which are more especially adapted for dry soils will probably perish. Well-drained land naturally suffers least. Land not so well drained becomes sour and unwholesome, and only the sedges and coarse water-grasses survive. The unsightly tussock grass, *Aira cæspitosa*, which frequently infests heavy soils, should be chopped up by the roots, carted into heaps, mixed with quicklime, and, when well rotted, spread upon the land.

“For destroying moss there is no better dressing than two cart-loads of lime mixed with eight cart-loads of light loam per acre: pure lime is too powerful to be applied alone. The heap should be turned several times until the lime is thoroughly slaked and well incorporated with the loam. After dragging the turf with heavy iron harrows, ten cart-loads of the compost should be spread over each acre. There will soon be a marked improvement, and a full return for the outlay. The effect of dragging a pasture is not everywhere appreciated at its full value. The mechanical action breaks up the congested surface, allows the atmosphere to penetrate to the roots, and thus promotes a free and healthy growth of the plants. It also enables the grasses to absorb and derive benefit from any fertilising agent or compost which may be applied to the surface, instead of allowing the dressing to be in great part washed away by the first heavy rain.”

The species of plants that enter into the herbage of pastures are not numerous. In the following table<sup>1</sup> are recorded all the species of grasses, leguminous plants, and other herbage, which we found growing upon eighty specimens of turf obtained from old grass lands in twenty-eight English counties, six Welsh counties, eight Scottish counties, and eleven Irish counties. In the great majority of cases these grass lands were rich old pastures, subject to continuous grazing and never mown; a few only were hayfields. The most abundant grass in old pastures is rye-grass, and the most abundant leguminous plant is white clover. *Ranunculus*, *Cerastium*, *Plantago*, and *Rumex* appear to be the most frequently occurring weeds.

*Gramineous Species or Grasses—Gramineæ.*

Botanical Name.	Common Name.
<i>Agrostis alba</i> , L.	Marsh bent grass
<i>Agrostis alba</i> var. <i>stolonifera</i> , L.	Fiorin
<i>Agrostis vulgaris</i> , With.	Fine bent grass
<i>Alopecurus pratensis</i> , L.	Meadow foxtail
<i>Anthoxanthum odoratum</i> , L.	Sweet-scented vernal grass
<i>Avena elatior</i> , L.	False oat grass
<i>Avena flavescens</i> , L.	Yellow oat grass
<i>Bromus mollis</i> , L.	Soft brome grass
<i>Cynosurus cristatus</i> , L.	Dogstail
<i>Dactylis glomerata</i> , L.	Rough cocksfoot
<i>Festuca loliacea</i> , Huds.	Spiked fescue
<i>Festuca ovina</i> , L., et var.	Sheep's fescue
<i>Festuca pratensis</i> , Huds.	Meadow fescue
<i>Holcus lanatus</i> , L.	Yorkshire fog, woolly soft grass

<sup>1</sup> From the Journal of the Royal Agricultural Society, 1890.

Botanical Name.	Common Name.
<i>Hordeum pratense</i> , Huds.	Meadow barley grass
<i>Lolium perenne</i> , L.	Rye grass
<i>Phleum pratense</i> , L.	Timothy, or meadow catstail
<i>Poa annua</i> , L.	Annual meadow grass
<i>Poa pratensis</i> , L.	Smooth-stalked meadow grass
<i>Poa trivialis</i> , L.	Rough-stalked meadow grass
<i>Triticum caninum</i> , Huds.	Bearded wheat-grass

*Leguminous Species—Leguminosæ.*

<i>Lathyrus pratensis</i> , L.	Meadow vetchling
<i>Lotus corniculatus</i> , L.	Common birdsfoot trefoil
<i>Trifolium minus</i> , Sm.	Yellow suckling clover
<i>Trifolium pratense</i> , L.	Purple or meadow clover
<i>Trifolium repens</i> , L.	White or Dutch clover

*Miscellaneous Species—Mostly "Weeds."*

Botanical Name.	Common Name.	Natural Order.
<i>Achillea Millefolium</i> , L.	Yarrow or milfoil (fig. 368)	Compositæ
<i>Bellis perennis</i> , L.	Daisy	Compositæ
<i>Bunium flexuosum</i> , With.	Earth-nut or jug-nut	Umbelliferae
<i>Cardamine pratensis</i> , L.	Cuckoo flower	Cruciferae
<i>Carduus</i> sp.	Thistle	Compositæ
<i>Carex</i> sp.	Sedge	Cyperaceæ
<i>Cerastium triviale</i> , Link.	Narrow-leaved mouse-ear chickweed.	Caryophyllaceæ
<i>Leontodon autumnalis</i> , L.	Autumnal hawkbit	Compositæ
<i>Leontodon hispidus</i> , L.	Rough hawkbit	Compositæ
<i>Luzula campestris</i> , Willd.	Field woodrush	Juncaceæ
<i>Plantago lanceolata</i> , L.	Ribgrass, ribwort, or plantain (fig. 369)	Plantagineæ
<i>Potentilla Anserina</i> , L.	Silver-weed or goose-tongue	Rosaceæ
<i>Prunella vulgaris</i> , L.	Selfheal	Labiatae
<i>Ranunculus acris</i> , L.	Upright buttercup	Ranunculaceæ
<i>Ranunculus bulbosus</i> , L.	Bulbous crowfoot or buttercup	Ranunculaceæ
<i>Ranunculus repens</i> , L.	Creeping crowfoot or buttercup	Ranunculaceæ
<i>Rhinanthus Crista-Galli</i> , L.	Yellow rattle	Scrophularineæ
<i>Rumex Acetosa</i> , L.	Common sorrel or sour dock	Polygonaceæ
<i>Rumex</i> sp.	Dock	Polygonaceæ
<i>Sonchus</i> sp.	Sowthistle	Compositæ
<i>Taraxacum officinale</i> , Web.	Dandelion	Compositæ
<i>Veronica Chamædrys</i> , L.	Germander speedwell	Serophularineæ



Fig. 368.—Yarrow or Milfoil.



Fig. 369.—Ribgrass or Plantain.

## CHAPTER IV.

## ON MEADOW LAND.

**U**NDER this head are included the grass lands that, lying for the most part in low or moist situations, are reserved chiefly for the making of hay. There is sometimes, however, great difficulty in determining what description of land is best fitted for grass, and what for the plough. The best meadow land does not always make the best tillage land, nor does the best arable produce the best pasture; but frequently the reverse.

The lands that are most adapted to remain in grass, and which, if in a state of tillage, ought to be converted into meadow or pasture, are the following:—

1. Lands in the vicinity of large and populous towns, where manure is cheap and plentiful, and where the produce of grass land is always in demand, and consequently dear.

2. Lands situated near rivers or brooks, and capable of being improved by irrigation to better purpose than can be effected under any other mode of culture.

3. Lands lying in the valleys of mountainous countries, particularly calcareous soils, where old meadow land is scarce and valuable.

4. All cold, strong, grass lands, which, if ploughed up, would be unsuited to the growth of turnips, and to the general purposes of modern husbandry, and which, under the best systems of wheat tillage, would not be so valuable as in their natural state of grass.

5. Peaty soils, for although they may by tillage be quite reclaimed from producing rank aquatic plants, yet, being too tender and moist to continue long in an arable state, they should be converted into that of permanent grass land as soon as it can be accomplished.<sup>1</sup>

It should be observed, that land intended for grass ought to be that on which the herbage will spontaneously thrive and flourish. Where there is too much moisture the grass will be injured in the winter by rain and frost, and will soon give place to rushes, and other aquatic plants, unless an effective system of drainage be established. On the other hand, if the soil is too dry, the grass will be killed by the summer heat, and will be succeeded by mosses, fern, and heather, unless irrigation can be applied to it. It might be supposed that this could be remedied by sowing such land with better grasses, and to a

<sup>1</sup> See Communications to the Board of Agriculture, vol. iii. pp. 79, 80, &c.

certain extent this may be done ; but experience has proved that all land has a tendency to reproduce those plants which are indigenous to the soil, and that, after a few years, varying according to the care and attention that have been bestowed on the cultivation, the natural productions will supersede those which have been artificially sown. This is one of the strongest reasons why sound old meadow land of rich quality should never be broken up until after the most mature consideration ; for to reproduce it, from land newly laid down, is one of the most difficult and uncertain operations of husbandry.

No land will make a good meadow unless the soil is sufficiently deep to allow the roots of the grasses to extend beyond the reach of the summer heat, sufficiently retentive to hold water long enough to contribute to the growth of the plant, and possessed of such an absorbent substratum as will drain away the moisture before putrefaction sets in. None but land of this description, therefore, should be laid down to grass, unless lime, clay, chalk, marl, or other ameliorating dressings can be procured on or near the spot.

Besides these considerations, there are other circumstances of very material importance in the laying away of lands in meadow. The following points will be found worthy of notice :—

1. A practical acquaintance with the best natural grasses, and their favourite soils.

2. Attention to early growth is of equal moment, especially as, from a variety of unforeseen accidents, the most careful farmer may not always have a stock of food adequate to the consumption of his cattle. The fluctuations in season will often produce considerable variation in the forwardness or the backwardness of grass crops. Hence the necessity of having enclosures that are warmly situated, not too humid, of a moderate size, and well sheltered, will be obvious ; for then the ill effects resulting from severe winters, or the prevalence of north-easterly winds during the spring, will be in some measure counteracted. The early grasses appear to be most coveted by cattle, and they will naturally thrive best on that which is most agreeable to their palate ; so that, an early bite, and an early hay-making and hay-harvest, and the consequent early use of the after-grass, or rowen, are very important objects to the farmer.

3. An acquaintance with the soils respectively favourable to various grasses, and with the relative hardiness of the latter, is another requisite, without which no good meadow can be formed ; and this can only be obtained by actual experience. Some grasses are less able to endure moisture than others, and of course flourish best in dry and upland situations ; while others are unfit for dry soils, but vegetate luxuriantly in moist lands ; others, again, are only fit for the poorest lands. There are, however, numerous grasses that will flourish in almost every soil, excepting in extremes of wet and dry. It is unnecessary here to specify the various species indicated, as they will be detailed in a subsequent chapter.

In laying down land to grass, the most important primary object is duly to prepare it for the reception of the seed. On account of the

minuteness of the seeds, and the generally fibrous nature of the roots of grass-plants, it is requisite to the formation of a good meadow that the soil should be previously brought into the highest possible degree of pulverization; otherwise the irregularity of the surface will not only occasion corresponding irregularity in the produce of the grass, to the great injury of the crop, but will likewise be found highly inconvenient when the meadow is mown. This necessary degree of fineness may be obtained in various ways, according to the nature of the soils: either by frequent ploughing and harrowing, or, on lighter soils, by the raising of turnips, potatoes, tares, and other fallow crops, which, by the shade they afford, as well as by the culture they require during their growth, are calculated to promote the reduction of the soil to a friable state.

Hitherto nothing has been said about renovating, and it is true that with liberal management it is quite possible to restore the fertility of grass land without sowing seed at all. But it will take time, perhaps many years, and it savours rather of a penny-wise and pound-foolish policy to occupy a long period in effecting an amelioration which might be accomplished in a single season at a very trifling outlay beyond that necessarily incurred in carrying out incidental improvements. In every case where the plant stands thin on the ground it will pay to harrow in a few pounds of the finer grasses and clovers per acre. "The seed may either be sown," says Mr. Sutton, "before the grass starts growth in February, or immediately the hay has been cut in June. February is, however, a very good time. On damp land, preparation should be made by an application of salt to the most weedy parts, and a severe dragging over the entire surface. A well-mixed compost of lime, the contents of ditches, and any other available rich material, should be distributed over the whole meadow, and the seeds can be sown on any day when the ground is dry enough to permit the roller to be used. Cattle may be allowed to depasture the land, but sheep must not be admitted until the following year. Upland pastures may be treated in a similar fashion."

The struggle for existence amongst the plants of a meadow does not strictly partake of that kind of internecine warfare which is waged between, for example, the individual members of a wheat crop. Leaving out of consideration the leguminous plants and miscellaneous herbage, there exist among the score or more species of Gramineæ which are represented in a meadow various morphological and physiological peculiarities which powerfully affect the extent to which a given species shall be abundant or otherwise. Shallow or deep roots, the presence or absence of stolons or other kinds of prostrate or underground stems, are examples of structural characters—whilst the periods of duration of the root-stock, the time of ripening of the fruit, and the capability of thriving under varied seasonal conditions, are instances of the functional peculiarities—which most influence the position any species of grass is to take when pitted in the struggle against other gramineous species.

Concerning the extent to which the proximate constituents of



meadow herbage are capable of varying in relative quantity, the Rothamsted experiments afford some valuable information. Out of as many as eighty-seven botanical analyses, made in four different years, of the hay from a score of differently manured plots of meadow land in Rothamsted Park, the maximum and minimum results are here set forth:—

—	Maximum per cent.	Minimum per cent.
Gramineous herbage . . . .	99·26	48·82
Leguminous herbage . . . .	39·77	0·00
Miscellaneous herbage . . . .	39·53	0·74

Thus, whilst the grasses in one case rose to as much as 99·26 per cent. of the total weight of hay (in the year 1872, on a plot receiving mixed mineral manures—sulphates of potash, soda, and magnesia, and superphosphate of lime—with silicates, every year), they exhibited every gradation down to as small a quantity as 48·82 per cent. of the total hay (in 1872, on a plot receiving mixed mineral manures, without silicates, each year). In the former case the hay may be said to have been all grass; in the latter case only half grass. The leguminous herbage once registered as high as 39·77 per cent. of the total hay (in the same year and on the same plot, just referred to, as gave only 48·82 per cent. of grass); in some cases it had dwindled down to nothing (in each of the four years, 1862–67–72–77, on the plot receiving mixed mineral manures and silicates, and, in 1887, on the plot receiving mixed mineral manures and ammonia salts). Lastly, the miscellaneous herbage, though it has reached as much as 39·53 per cent. of the total hay (in 1867, on a plot receiving yearly the mineral constituents and the nitrogen equal to the quantity of these ingredients contained in one ton of hay), has fallen as low as 0·74 per cent. (on the same plot as gave the maximum of 99·26 per cent. of grasses). These great fluctuations upon ordinary meadow land, subjected to many different kinds of continuous manuring, serve to bring into greater prominence the uniformity in the percentages of the proximate constituents of the hay of water meadows as detailed (p. 885) in the subsequent chapter on Irrigation. It may be added that very wide fluctuations are noticeable even upon one and the same plot of meadow land, receiving continuously the same manure, at Rothamsted. Such variations must be attributed to seasonal influence, whereas one of the most noteworthy features in the economy of water meadows is that they are rendered largely independent of, and therefore in only a lessened degree susceptible to, variations in seasonal characters.

Some additional observations may appropriately be made on the world-renowned experiments, conducted at Rothamsted Park, Hertfordshire, upon meadow land. Meadow herbage, it will readily be acknowledged, offers to the agricultural investigator about as complex a subject for study as can well be imagined. Some 7 acres of the land

in Rothamsted Park were, in 1856, set apart for "Experiments on the Mixed Herbage of Permanent Meadow," and were divided at first into nine and ultimately into twenty plots. Two of these have been left without manure from the commencement; two have received ordinary farmyard manure continuously; whilst the remainder have each received a different description of artificial or chemical manure, the same being, except in special cases, applied year after year on the same plot. The land has probably been laid down with grass for some centuries. No fresh seed has been artificially sown within the last fifty years certainly, nor is there any record of seed having been sown since the grass was first laid down. The land is a somewhat heavy loam, with a red clay subsoil resting upon chalk, and, although not artificially, is very well naturally, drained; it is a perfectly level area. For many years prior to 1851 the general mode of treatment was to dress occasionally with farmyard manure, road-scrapings, and the like, and sometimes with guano or other purchased manure. One crop of hay was removed annually, weighing from  $1\frac{1}{4}$  to 2 tons per acre; the second crop was always eaten off by sheep.

During the first nineteen years—1856 to 1874—the first crop only each year was mown, made into hay, removed from the land, and weighed. As a rule, the second crop on each plot was fed off by sheep, who received at the time no other food, the object being not to disturb the condition of the manuring.

Without manure, the produce of hay has varied from about 8 cwt. to nearly 39 cwt. per acre, and the average yield has been about 23 cwt. per acre per annum. But the plot most heavily artificially manured, and yielding the best, has given an average of about 64 cwt. of hay per acre per annum, the extremes being 40 cwt. and nearly 80 cwt. The results on the other differently manured plots vary greatly within these limits. At the same time, the botanical composition of the herbage has varied most strikingly, so that, starting with some fifty species of plants on the unmanured land, any kind of manure induces a struggle which leads to a diminution of the number of species down to twenty, or even fewer, though it must not be overlooked that such diminution of specific forms may be quite compatible with an increase in the total yield of herbage.

The subjoined details concerning the botanical composition of the herbage are interesting as showing what plants may be expected to occur in ordinary hay fields.

Of Gramineæ, or grasses, the following twenty species include all that have been identified upon the plots.

*Gramineæ.*

- |   |                                    |
|---|------------------------------------|
| 1. Anthoxanthum odoratum, L. . . . .                                | Sweet scented vernal grass         |
| 2. Alopecurus pratensis, L. . . . .                                 | Meadow foxtail                     |
| 3. Agrostis vulgaris, With . . . . .                                | Creeping-rooted bent grass         |
| 4. Holcus lanatus, L. . . . .                                       | Yorkshire fog                      |
| 5. Avena elatior, L., or<br>Arrhenatherum avenaceum, Beauv. . . . . | False oat grass, or tall oat grass |
| 6. Avena pubescens, L. . . . .                                      | Downy oat grass                    |
| 7. Avena flavescens, L. . . . .                                     | Yellow oat grass                   |

8. <i>Poa pratensis</i> , L. . . . .	Smooth-stalked meadow grass
9. <i>Poa trivialis</i> . . . . .	Rough-stalked meadow grass
10. <i>Dactylis glomerata</i> , L. . . . .	Rough cocksfoot
11. <i>Festuca ovina</i> , L. . . . .	Sheep's fescue
12. <i>Lolium perenne</i> , L. . . . .	Perennial rye grass
<hr/>	
13. <i>Briza media</i> , L. . . . .	Common quaking grass
14. <i>Cynosurus cristatus</i> , L. . . . .	Dogstail
15. <i>Festuca pratensis</i> , Huds. . . . .	Meadow fescue
16. <i>Bromus mollis</i> , L. . . . .	Soft brome
<hr/>	
17. <i>Phleum pratense</i> , L. . . . .	Timothy grass
18. <i>Aira cæspitosa</i> , L. . . . .	Tufted hair grass
<hr/>	
19. <i>Festuca elatior</i> , L. . . . .	Tall fescue
20. <i>Festuca loliacea</i> , Huds. . . . .	Rye-leaved fescue

Of the foregoing species the first twelve are of common occurrence upon all the plots. Nos. 13, 14, 15, 16, though very general, do not invariably occur upon each plot. Nos. 17 and 18 do not appear upon one-half, and in some years not upon one-fourth, of the plots. The last two species are extremely rare.

Of Leguminosæ, whilst ten species have been identified, there are only four of common occurrence upon the plots. These are:—

*Leguminosæ.*

<i>Trifolium repens</i> , L. . . . .	White or Dutch clover
<i>Trifolium pratense</i> , L. . . . .	Purple or meadow clover
<i>Lotus corniculatus</i> , L. . . . .	Common birdsfoot trefoil
<i>Lathyrus pratensis</i> , L. . . . .	Yellow or meadow vetchling

Of miscellaneous species as many as fifty-nine have been recorded. Below are mentioned those which commonly occur on more than half the plots, and they are arranged in the order of the frequency of their occurrence, each species indicated being more often recorded than any of those named after it. The upwards of forty remaining miscellaneous species are of decidedly rare and uncertain occurrence.

*Miscellaneous Species—mostly "Weeds."*

Common Name.	Botanical Name.	Natural Order
Rumex Acetosus, L. . . . .	Sorrel . . . . .	Polygonaceæ
Conopodium denudatum, Koch., or Binnium flexuosum, With. . . . .	Earth nut . . . . .	Umbelliferae
Achillea Millefolium, L. . . . .	Milfoil or yarrow . . . . .	Compositæ
Pimpinella Saxifraga, L. . . . .	Burnet saxifrage . . . . .	Umbelliferae
Luzula campestris, Willd. . . . .	Field woodrush . . . . .	Juncaceæ
Ranunculus acris, L. . . . .	Upright buttercup . . . . .	Ranunculaceæ
Ranunculus bulbosus, L. . . . .	Bulbous crowfoot, or buttercup . . . . .	Ranunculaceæ
Centaurea nigra, L. . . . .	Black knapweed . . . . .	Compositæ
Cerastium triviale, L. . . . .	Mouse-ear chickweed . . . . .	Caryophyllaceæ
Galium verum, L. . . . .	Yellow bed-straw, or cheese-rennet . . . . .	Rubiaceæ
Stellaria graninea, L. . . . .	Lesser stitchwort . . . . .	Caryophyllaceæ
Plantago lanceolata, L. . . . .	Ribwort, ribgrass, or plantain . . . . .	Plantaginæ
Veronica Chamædryas, L. . . . .	Germander speedwell . . . . .	Scrophulariæ
Taraxacum officinale, Wigg. . . . .	Dandelion . . . . .	Compositæ
Carex præcox, Jacq. . . . .	Vernal sedge . . . . .	Cyperaceæ
Heracleum Sphondylium, L. . . . .	Cow-parsnip . . . . .	Umbelliferae

Details as to the nature and amount of the yield under each condition of manuring will be found in a separate volume upon the Rothamsted Experiments.<sup>1</sup> We cannot do more here than introduce the following table showing the average amount of nitrogen, and of most of the mineral constituents, removed in one acre each of fair crops of wheat, barley, and meadow hay. For this purpose the following yields per acre are assumed:

Wheat, 30 bushels=1,800lb., and 3,000lb. straw=4,800lb. total produce.

Barley, 40 bushels=2,080 lb., and 2,500 lb. straw=4,580 lb. total produce.

Meadow hay 1½ tons, or 3,360 lb. Meadow hay varies so greatly in its botanical and chemical composition, according to soil, climate, and manuring, that it is necessary to take mean results:—

*Per Acre.*

COMPOSITION OF AVERAGE CROPS OF WHEAT, BARLEY, AND MEADOW HAY.

	In grain.		In straw.		In total produce.		In 1½ tons = 3360lb. meadow hay.			
	Wheat (1800 lb.)	Barley (2080 lb.)	Wheat (3000 lb.)	Barley (2500 lb.)	Wheat (4800 lb.)	Barley (4580 lb.)	A (8 yrs. farm-yard manure)	B (8 yrs. without manure)	Mean of A and B.	Average of 39 analyses (E. Wolf).
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
Nitrogen . . .	32·0	33·0	13·0	12·0	45·0	45·0	40·8	47·2	44·0	52·0
Lime . . . . .	1·0	1·5	7·5	9·0	8·5	10·5	27·1	35·2	31·2	33·8
Magnesia . . .	3·5	4·0	3·0	2·5	6·5	6·5	7·4	9·4	8·4	12·8
Potash . . . .	9·5	11·0	22·0	23·0	31·5	34·0	72·8	40·5	56·6	51·7
Soda . . . . .	0·2	0·5	1·0	3·0	1·2	3·5	7·9	16·0	11·9	9·0
Phosphoric acid	15·0	16·5	6·0	4·5	21·0	21·0	16·4	11·0	13·7	16·2
Sulphuric acid.	0·2	0·75	4·0	4·0	4·2	4·75	11·3	13·6	12·5	9·2
Chlorine . . .	0·0	0·2	3·0	4·0	3·0	4·2	21·3	12·3	16·8	14·6
Silica . . . .	0·5	11·0	95·0	55·0	95·5	66·0	59·9	51·8	55·9	54·6

These figures, read from left to right, will be found most instructive. Assuming as the basis of comparison the mean composition of the manured and the unmanured hay, it is seen that a fairly good crop of hay will remove about one-third more nitrogen than the grain of a fairly good crop of wheat or barley, and practically the same amount as the total produce, grain and straw together, of either of the corn crops. Of phosphoric acid, the hay crop will remove somewhat less than the grain alone, and only about two-thirds as much as the total produce of wheat or barley. Of potash, the assumed average hay crop will remove five or six times as much as the grain of either the wheat or barley, and nearly twice as much as the total produce, grain and straw together. Of lime, soda, sulphuric acid, chlorine, and silica,

<sup>1</sup> "The Rothamsted Experiments on the Growth of Wheat, Barley, and the Mixed Herbage of Grass Land." By W. Fream: Published by Horace Cox, "The Field" Office, Bream's Buildings, Chancery Lane, London, E.C. 5s. 6d.

the hay will remove many times more, and of magnesia much more, than either the wheat or the barley grain. Of lime, soda, sulphuric acid, and chlorine, the hay will also remove much more, and of magnesia more, than both grain and straw together. Of phosphoric acid and silica alone will the total produce of the corn crops remove more than the hay crops.

Summing up the salient points, it becomes apparent that in Rothamsted Park, where the soil is a loam with clay subsoil, the effect of the application of a complex fertiliser like farmyard manure, supplying as it doubtless does much more of all the mineral constituents than the crop takes up, is in a striking degree to increase the assimilation of potash—notably also that of phosphoric acid, and to some degree that of silica; much more chlorine is also taken up. Indeed, the experiments prove that the supply by manure of potash has a more marked effect on the quantity, and on the botanical and chemical character, of the herbage of the hay crop, than that of any other of the mineral or ash constituents.

The history of a field newly laid down to permanent grass formed the subject of a paper contributed by Sir J. B. Lawes to the "Journal of the Royal Agricultural Society" in 1889. The land had been laid down nearly thirty years, and had been mown for hay every year from the commencement. In 1856 barley and grass seeds, costing 32s. per acre, were sown, but the grass seeds failed. Barley and grass seeds were again sown in 1857, but the grass seeds again failed. Red clover was sown in 1858, yielding a small crop that year, and a larger one in 1859. After removal of the clover, grass seeds were again sown, and this time succeeded. In 1860 and 1861 artificial manures only were applied. As, under this treatment, the leguminous herbage was found to be very scanty, some alsike and Dutch clover seed were sown in 1862, and a heavy dressing of dung, at the rate of 11 tons 17 cwt. per acre, was applied, with a little superphosphate and nitrate of soda in addition. In 1863 dung was again put on, at the rate of 4 tons 13 cwt. per acre; but in 1864 and 1865 artificial manures only, consisting of superphosphate, nitrate of soda, and a little sulphate of potash, were used. Henceforth, more attention was paid to the field, the object being to maintain the character of the herbage, and at the same time to obtain as large crops of hay as were consistent with the maintenance of this condition. It was sought to keep up the quality by means of dung, and to secure full quantity by the use of artificial manures in addition, consisting of superphosphate and sulphate of potash, with guano, or nitrate of soda, or both, as nitrogenous manure. After the first few years the general plan adopted was to apply two or sometimes three trucks of London dung every other year, but occasionally it was applied only every third year; artificial manures, were, however, with one or two exceptions, applied every year. The table on the next page shows the *annual* average applications and yields *per acre* in the several periods:—

	MANURES APPLIED.					Produce of hay.	
	Dung.	Super-phosphate.	Sulphate of potash.	Guano.	Nitrate of soda.		
	tons. cwt.	lb.	lb.	lb.	lb.	tons. cwt.	
8 years, 1866-73 . . . . .	2 10	24	16	66	74	1 8	
8 years, 1874-81 . . . . .	3 16	101	65	8	130	1 13 $\frac{1}{2}$	
7 years, 1882-88 . . . . .	4 0	57	57	0	67	2 3 $\frac{1}{2}$	
23 years, 1866-88 . . . . .	3 8	61	46	26	91	1 14 $\frac{1}{2}$	

It is seen that there was a gradual increase in the quantity of dung applied. Of artificial manures there was an increase, both of the mineral and of the nitrogenous, over the second period compared with the first; but there was a reduction over the third period. It was found that, in the circumstances, the application of as much as 1 cwt. of nitrate of soda per acre per annum was liable to give a too stemmy, and almost exclusively grassy herbage. Hence the quantity was reduced, until it was found that, with the amount of dung and of artificial manures used, about  $\frac{3}{4}$  cwt. of nitrate of soda per acre per annum was sufficient to yield as full a crop as could be obtained without reducing the bottom herbage, and therefore the quality of the hay. It is obvious, from the increase in the yield, that the condition of the land gradually improved.

In attempting to make out a balance-sheet of the results it is impossible to be strictly accurate, owing to the number of years involved, and to fluctuations in prices, both of manures and of produce. The expenses of hay-making may be considered as set against the rent obtained for feeding the after-grass, as this wholly met the cost, and perhaps more. At the prices stated below, which are as nearly correct as possible, the balance-sheet, *per acre per annum*, 23 years, 1866 to 88, comes out as follows:—

*Expenditure.*

	<b>£</b>	<b>s.</b>	<b>d.</b>
3 tons 8 cwt. purchased dung, including carriage, cartage, and spreading, at 7s. 6d. per ton . . . . .	1	5	6
61 lb. superphosphate, at 5s. per cwt. . . . .	0	2	9
46 lb. sulphate of potash, at 15s. per cwt. . . . .	0	6	2
26 lb. guano, at 11s. per cwt. . . . .	0	2	6
91 lb. nitrate of soda, at 16s. per cwt. . . . .	0	13	0
Total for manures . . . . .	2	9	11
Rent (as arable), tithe, and rates . . . . .	1	10	0
Harrowing, rolling, and occasional labour . . . . .	0	10	0
Total . . . . .	4	9	11

*Receipts.*

1 ton 14 $\frac{1}{2}$ cwt. of hay sold, at 4l. per ton . . . . .	6	18	6
Balance in favour of Receipts . . . . .	2	8	7

It appears, therefore, that a good permanent grass-field had been formed upon this arable soil in Hertfordshire, not only without loss, but with some profit. Much of the success was doubtless due to the town dung, and to the comparatively small cost of cartage, owing to the field being but half a mile from the railway station. The results of annual mowing for nearly thirty years are held to show that fair quality of herbage, as well as full quantity, may be maintained, provided judgment be exercised in the manuring. The general conclusions may be thus summarised :—

1. By the judicious employment of manures, both natural and artificial, arable land was converted into permanent grass, not only without loss, but with some profit to the tenant.

2. The important constituents, nitrogen and phosphoric acid, were proved to be supplied in the manures in larger quantities than they were removed in the crops; but potash in only about the same quantity as it was removed.

3. The application of dung not only compensated for much of the exhaustion due to the removal of hay, but it had a beneficial influence on the botanical composition of the herbage.

4. Although the grass had been mown every year for nearly thirty years, there had been a considerable accumulation of fertility within the soil.

5. Analysis showed that there had been an increase of nitrogen in the surface-soil, beyond that which could be explained by excess supplied in manure over that removed in crops, and by the combined nitrogen coming down in rain, and in the minor deposits from the atmosphere.

6. On laying down arable land to permanent grass, especially if hay is to be removed, it is essential to supply, not only nitrogenous, but an abundance of mineral manures, and especially of potash, a large quantity of which is removed in the crops, and must be returned. When the grass is not mown, but fed, the exhaustion is much less, but it is greater when consumed for the production of milk than when for that of store or fattening increase.

## CHAPTER V.

### ON THE CULTURE OF GRASS LAND.

**I**N laying land away to grass there are two conditions, compliance with which is absolutely indispensable to permanent success: 1st, the land must be clean; 2ndly, the selected seeds must be pure. Compliance with only one, and not the other, of these conditions is futile; for it is equally useless to sow pure seeds upon a foul seed-bed

as to prepare a clean seed-bed for the reception of a bad sample of seed.

**SELECTION OF SEED.**—It is, in one respect, unfortunate that the quantity of seed, measured by the number of individual specimens in a single purchase, is so great that there is much danger lest the quality be overlooked. There are at least three prominent factors involved in the idea of quality; these are—(1) germinating capacity, (2) freedom from impurities, (3) trueness to species. The germinating capacity is easily determined by counting out 100 seeds from the sample, and placing them under conditions favourable to germination, as upon a roof-tile standing to half its depth of water in a dish; then by counting the number that “strike”—to use a gardener’s term—the capacity for germination is at once indicated as a percentage. It will usually be found that if several trials be made from the same sample a certain degree of variation is observable, but, as a rule, the trial made with the first hundred seeds counted out is a fair and reliable test, though it is more so in some cases than in others. Obviously the larger the number of seeds submitted to the test the greater is the value of the result, and it can always be expressed as a percentage. At the New York Agricultural Experiment Station some germinating trials were made of, in this case, cabbage seed from the various crops of the year 1885. In all, 32,800 seeds taken from 164 different samples of cabbage seed were placed under conditions favourable to germination, and 25,150 seeds germinated. This is equivalent to 76·7 per cent., but, as a matter of fact, the germinating capacity of seeds from the different samples ranged from as low as 48·1 to as high as 94·7 per cent. The former result was abnormally low, the next above it being 56, and the next 68 per cent. According to the regulations of the Royal Agricultural Society of England the germination of cereals, green crops, clovers, and timothy grass should be not less than 90 per cent.; of foxtail not less than 60 per cent.; of other grasses not less than 70 per cent.

The impurities in a sample of seed demand the most careful attention on the part of a purchaser. They may be classed as harmless and injurious. Under the former head would come fragments of earth, stone, and vegetable matter, and also dead seeds; the latter would include seeds of weeds and of certain parasites. A buyer need not worry himself about the harmless impurities, they merely mean so much less good seed. Suppose a sample to contain, say, as much as 5 per cent. of these harmless impurities, then in purchasing 20 lb. of such seed the buyer would get 19 lb. good seed and 1 lb. rubbish, the latter costing as much per lb. as the seed. The more difficult that seeds are to clean for the market the more likely are they to contain objectionable impurities. On the other hand, the more thoroughly seeds are cleaned, the higher is the price the seedsman is bound to charge to recompense him for the expense of cleaning. The question for a buyer is simply whether the extra purity of the sample is worth the extra money asked. And the most practical way to answer this



question is to propound another, which we have already anticipated, namely, Is it worth while preparing at great expense a good seed-bed, if you are going to foul it by sowing thereon dirty seed?

In every kind of grass and clover seed, and indeed in all kinds of farm seeds, there may occur, and usually do occur, the seeds of certain weeds. In Chapter I. of Book the Tenth (p. 893) are stated for each kind of grass seed the weed seeds most likely to be found in it. Obviously, no one would willingly, or purposely, sow seeds of plantain, sorrel, self-heal, buttercup, cranesbill, wild-carrot, dock, blue-bottle, Yorkshire fog, or soft brome, if he could possibly help it, and yet it is to be feared that such seeds as these find their way into the seed-barrow in much greater proportion than might be imagined. Hence, in purchasing seed it is desirable to examine the sample very carefully and to satisfy oneself that all the seeds are alike; if there is even a small proportion of seeds unlike the bulk, the sample should be rejected. Experience shows that the unaided eye is scarcely competent to detect impurities in grass and clover seeds. If, however, the sample is spread out on a sheet of white paper and slowly passed under a magnifying glass, it is sometimes surprising to see the quantity of impurities thus detected. In the case of grass seeds more skill is required, for certain species are liable to contain worthless grasses, the seeds of which bear so close a resemblance to those of the true sample, that detection becomes difficult. Yet another class of injurious impurities are such parasites as dodder and ergot—the former in clover seed, the latter in grass seed. With a little care these are by no means difficult to detect, and probably the best advice to give regarding these pests is that the samples containing them should be rejected, and not used for sowing under any circumstances whatever.

Granting that a sample is pure, and that it is of satisfactory germinating capacity, there remains the question: Is it what it purports to be? Is it true to the species ordered? In many cases there is no difficulty in answering this question. In some, however, it is not only difficult, but impossible. For example, who can say whether a sample offered as that of fiorin grass (*Agrostis alba stolonifera*) at 1s. per lb. is not that of twitch (*Agrostis alba*), which is worth less than nothing? Who can distinguish the seeds of cabbage from those of kohl rabi, of swede from rape, or of turnip from kale? The skill of the botanist and the dexterity of the microscopist are alike ineffectual in cases such as these, in which the seeds of different plants are exactly alike. The resemblance in each case is a strong and unmistakable family likeness.

A still more difficult problem presents itself in the case of the seeds of improved and unimproved varieties of the same plant. The best mangel grown is only an improved variety of the wild beet of our coasts, and perennial white clover has the same ancestry as common Dutch. In the one case the plant has been trained and cultivated, and thereby improved; whilst in the other it has continued to run wild. But the improvement, be it observed, has not extended, to the seed—in so far, that is, as visible characters are concerned—simply because the seed has not in

these examples been the object of cultivation. The reverse is the case with cereals, which are grown expressly for their grain; and to the improvement and differentiation of the latter all cultural efforts have been directed. And yet, if two specimens of seed are taken, the one of the wild beet and the other of globe mangel, though they may afford no clue to their origin even when subjected to the most careful examination, the inherited qualities are nevertheless hidden away in some mysterious manner in the microscopic embryo within, and will reveal themselves as the plant develops. Nobody can assert that the wonderful effects which pedigree produces amongst farm animals are not also exemplified in farm plants. Faraday is credited with having said that no clever man has ever yet sprung from really stupid parents, and it would be as reasonable to expect a good crop from seed of ill pedigree as to look for figs upon thistles, or grapes upon thorns.

It is worth quoting, as an example, an interesting case of seed selection made at the New York Station. From the stock of oats in the granary, 1,000 of the smallest grains and 1,000 of the largest grains were selected. The large ones weighed altogether one and one-fourth ounces, the small ones nine-sixteenths of an ounce. On May 4, the two lots of oats were sown under the most uniform and similar conditions possible. On May 12, the large oats were seen to be vegetating more rapidly than the small ones. On June 8, the numbers of plants were: Large oats, 823; small oats, 650. By June 23, the plants from the large oats were larger and more robust than the others, and subsequently they showed a tendency to ripen earlier. On August 6 both crops were cut, and afterwards threshed and weighed. Here is the result:—

	Grain. lb. oz.	Straw. lb. oz.
Large oats crop . . . . .	11 14	34 12
Small oats crop . . . . .	8 15	32 6

More than this, 10,000 grains of each plot were weighed; those of the large oats crop weighed 19.92 grams, an equal number of the small oats crop gave 19.21 grams. A case of this kind may serve to show how by continual selection of seed a race of plants may be steadily improved.

As regards the germinating capacity of seeds, if in a given case it hardly comes up to the highest standard, this nevertheless should hardly be regarded as a serious drawback. It is unwise policy to purchase a sample which obviously has not been well cleaned from living impurities; there is, it is true, the temptation offered of a much lower price, but seed containing injurious impurities is dear at a gift. In the third place, as to a sample being true to the species ordered, an opinion ought to be taken in doubtful cases, but both in this and in the fourth case—that of improved seed being what it purports to be—the buyer is really in the hands of the seedsman. It is only possible to suggest that he should go to a seedsman whom he has learnt by experience to trust, or whose reputation is such that he ought to be trustworthy, and on this point he must trust his seedsman just as he

would his solicitor or his physician. It comes to a matter of confidence between buyers and sellers, and the former can only proceed upon the principle, "By their work ye shall know them." The best seed is usually worth the extra money asked for it. It is true that a farmer, every time he constitutes himself a committee of ways or means, has to look at every expenditure as one that may possibly be reduced to narrower limits. But it is questionable whether it is wise economy to pinch the seed bill. A very few pounds will make a great difference in the character of the seed which is supplied and, in the long run, will more than justify the additional outlay. It must never be forgotten, however, that good seed deserves a clean seed bed—more, it demands it.

PREPARATION OF SOIL.—No farm crop, Mr. Sutton truly observes, requires more care in the preparation of the land than does a crop of permanent grasses; and there cannot be greater folly than to sow costly seeds, especially of the finer varieties, on land which has not been adequately prepared to receive them.

"Sharp sands and gravels are not well adapted to the formation of pastures, but heavy loams and most strong clays are eminently suitable for grasses and clovers, and will produce abundant crops. The fact that heavy soils are expensive to work in arable cultivation is an additional reason why they should be laid down to grass. When there is a choice of two fields, one sloping to the north and the other to the south, preference should be given to the former, because it will be less liable to burn in a hot summer.

"If the land is naturally well drained, there will be a fortunate saving of expense, but otherwise this operation should be preliminary to all else.

"Beyond question, the very best preparation for a spring sowing of permanent grass seeds is a bare fallow in the previous summer. This affords the opportunity of destroying successive crops of indigenous annual weeds, and, within three months from the date of sowing, it is important that these should be got rid of by scarifying and dragging rather than by ploughing, for the plough is only too certain to bring to the surface a fresh stock of weed seeds ready to germinate in the following spring. Many influences may aid or hinder the work of preparation. It depends not only upon the character of the soil and the previous cropping, but also upon the atmospheric conditions which prevail while the operations are in progress, and it is here that the advantage of a bare fallow is realised. There are the whole summer and early autumn in which to accomplish the task.

"Deep ploughing should be carried out first, and if subsoiling is considered necessary there is all the greater reason for doing it early. Then, by means of the scarifier and the roller, the soil can be cleaned and so far prepared to receive the seeds that in the following spring only one or two turns with the harrow will be necessary to perfect the seed-bed. There are good reasons for insisting on a thorough preparation of the land in the first instance. Careless and half-hearted work

wastes both seed and labour, and the necessary operations have to be attempted a second time under great disadvantages. Causes entirely beyond human control may sometimes render it needful to re-sow, even after the most earnest effort; but no one should lay himself open to the possibility of self-reproach for having contributed to partial failure by neglect. More of the failures in attempting to create pastures could, if all the facts were known, be traced directly to the unfavourable state of the soil, and to its previous cultivation, than is generally believed, and it is true wisdom, as well as sound economy, to wait a year, or even two years, rather than risk sowing upon soil which is foul or out of condition.

“As a rule, however, bare fallow cannot be afforded. In the interests of the coming pastures, a root crop is the next best preparation, and unless the land is capable of growing a first-class crop of roots it will be incompetent to produce even a fair pasture. Now a root crop offers this advantage, that, while few are disposed to manure a bare fallow heavily, a thorough dressing of farm-yard dung will not be denied to the mangel or swede crop. To the young grasses also it is a great gain when the land can be made rich and put into good heart before the sowing takes place, in preference to their being dependent on manuring processes immediately before or after the seed is put in. The tender and delicate roots of young grasses may be seriously impaired by contact with raw manure, and the growth of the plants thereby retarded. On the other hand, they will readily assimilate the previous year's rich dressing, which has had time to become mellow, or to be absorbed into the staple.

“Supposing land is prepared by feeding off a crop of turnips with sheep, it may happen that the turnips have to be supplemented with meadow hay. If so, it is important that the hay should be only such as has been cut very early, otherwise the ripe seeds of the grasses will pass the sheep undigested, and in due time spring up and make the pasture foul. Such grasses as Yorkshire fog and other worthless varieties often find their way into a pasture in this manner. This is notably the case with the hay of water meadows.<sup>1</sup>

“Whether the roots are fed off during September or October by sheep eating hay or cake—and the use of cake is to be strongly commended—or whether the roots are carted off during autumn, in either case the plough should be put into the ground the moment the latter is free. This first ploughing must be deep and thorough, and should be quickly followed by another ploughing to lay the land up rough for the winter. In February, or as early as the land is workable, get the harrow and the roller upon it until the seed-bed is fine, firm, and level. A tenacious soil, which dries off lumpy, may involve the expenditure of much time

<sup>1</sup> As bearing upon this point, it may be mentioned that it came under my notice that, upon arable land in Wilts and Hants, rows of Yorkshire fog would sometimes spring into existence from no apparent cause. Upon inquiry it was found that these rows appeared in places where sheep-troughs had stood; amongst the food put into the troughs was water-meadow hay, the ripe “seeds” of the Yorkshire fog in which, becoming easily disengaged and falling to the ground, gave rise in the course of the season to rows of the grass plant itself.—W. F

and energy to put it into good order. The delay will prove tantalising, but impatience is a bad husbandman, and the implements must be kept going until a satisfactory finish is obtained. Few grass seeds will grow at a greater depth than half an inch even in fine friable soil. In cracks and fissures they will be utterly lost. Hence a sowing on ground which is rough is foredoomed to partial or entire failure, and the plants which do come will be the coarser varieties only. Tilth, therefore, is all important.

“Consolidation is equally important, for the young grasses cannot obtain foothold upon a loose or hollow soil. In such a case it is impossible to secure a perfect plant; and here again the finer sorts will fail. It is no unusual thing to see a capital plant of grass all round the headlands of a newly sown field, while the centre is thin or bare. The explanation is simply this: the greater traffic over the headlands created a firmer seed-bed for the grasses than was made for them elsewhere.

“Even after the land has been fully prepared for the seeds, it will be all the better if allowed to lie untouched for a few days before sowing; but if the season is advanced waiting may be dangerous. Otherwise the delay offers two advantages. It allows the soil further time to settle down, and also gives the annual weeds a chance to start, so that by a final turn of the harrow they may be killed before the grass seeds are sown. Annual weeds, unfortunately, are sure to come only too plentifully, and will demand constant attention when grass seeds are sown without a corn crop in spring.

“As a preparation for autumn sowing, no other crop is equal to an early variety of potato. The earthing up of the rows exposes a great surface to atmospheric influences, and this materially aids the disintegration of the soil. Another point in its favour is that the crop is generally lifted by hand, and thus the soil is subjected to a course of spade husbandry, which, as a preparation for grass, is superior to all other modes of cultivation. When digging the crop the benefit may be further augmented by instructing the labourers to fork up and throw aside every bit of couch they come across. This will very effectually assist the cleaning process. The only objection to sowing immediately after potatoes is the difficulty of consolidating the land; but by planting a first early variety, such as Field Ashleaf or Early Regent, the crop can be marketed early in July, and before the grass seeds are sown in August a persistent use of the harrow and roller will do much to make a firm seed-bed.”

It is sometimes necessary that land be laid away to grass at the earliest possible moment, whether in a fit condition for the purpose or not. “One of the commonest instances is that of a clover ley which is wanted as a permanent pasture. There is a natural feeling of reluctance to break up the clover plant, and the hope is indulged that grass seeds will “take” upon it. The objections to this course are many and serious, although they are not always insurmountable. Possibly indigenous weeds have already such a hold of the ground as to afford very little chance of the grasses making headway against them. But

whether this be so or not, in soil crowded with clover roots the young grasses will have but scant opportunity of establishing themselves. Still, however risky the practice of turning a ley into a permanent pasture must ever remain, necessity knows no law, and sometimes this unpromising experiment is crowned with success. Those who leave much to chance will deserve and obtain a poor result; but the man who is persistent and determined to succeed will often secure a fair return for his labour and expenditure. The chief inducement to make the attempt is the probable saving of a considerable outlay in breaking up the land and getting it ready to sow down again.

“The first process in converting a clover ley should be a vigorous harrowing in the autumn, and it must be no child’s play. There need not be the least occasion for alarm in the apparent wreck of the standing plant. The more ruthlessly it is torn the better chance will there be for the grass seeds, and the more satisfactory the ultimate pasture. Follow up with a top dressing of cake-fed manure or compost early in the winter, and the land will then be, although only in a limited and imperfect manner, prepared to receive the grass seeds in the following spring.” The advantage of shelter provided by the old clover plants will more than outweigh any possible harm which even crude manure might inflict on the young grasses in the spring. “As to the choice of seeds, it is mere waste to sow fine or weak-growing varieties on an old clover ley. The adverse circumstances of the case will afford them little chance of struggling into life, to say nothing of a profitable existence. The sorts selected must be the stronger and more robust of the perennial grasses, and the seed should be got in early, before the clover has time to shoot vigorously in spring. Accomplish the task in February if possible; bush-harrow after sowing, and as a finish put the roller over every part of the field.”

In other cases glebe or similar land may have been neglected for so many years that it has become a perfect mat of couch or of black bent. In despair of cleaning it at a reasonable cost, the occupier decides to allow it to “go to grass,” as hundreds of acres have actually gone, particularly since 1879. “Wisely it is considered desirable to give Nature some assistance, but it is almost a misnomer to dignify that assistance by the name of preparation. In this instance also the routine previously advised is applicable. Rigorous harrowing in autumn, a heavy top-dressing during winter, and the sowing of suitable strong-growing seeds in early spring, are the means by which the most profitable results can be ensured. This rough-and-ready mode of treatment has often been followed by a fairly paying plant. Especially may improving crops be anticipated when the land is continuously manured, or where the cattle which feed them off are liberally assisted with artificial food.”

Other instances of a similar character might be cited, but as they only need some modification of the method already described, it may be enough to say that tolerably successful pastures have been known to be formed from an old sainfoin ley, a worn-out lucerne plant, a three or four years’ rye-grass ley, and even from clean barley and

oat stubbles, without ploughing or using any other implement than the harrow, the seed-barrow, and the roller.

Before proceeding to lay land away in grass it is desirable to acquire a clear understanding of the condition and capabilities of the soil. The subsoil, too, must be taken into account, for sooner or later its influence will tell decisively upon the existence of certain grasses. Then the purpose of the grass crop must not be overlooked. Whether it is chiefly for hay or entirely for grazing will prove an important factor in determining the kinds of seed to be sown. Even the nature of the stock the land is intended to carry is worth consideration. Milch cows, fattening stock, sheep and horses, or a combination of these animals, can be provided for if a definite object is held steadily in view.

A fine firm seed-bed having been prepared, it is further necessary that the soil should be dry enough to allow the implements to work freely without any tendency to gather in clods on the roller, though waiting for this will often tax the patience of the farmer.

The first operation, Mr. Sutton remarks, is "to run the harrow over the land to prepare it for the seed, and the sowing may be either performed by the hand or by means of the common seed-barrow. Some men are skilful in spreading seeds uniformly by hand, and on a still day their work answers well. But grass seeds are light, and it does not need a very high wind to make the sowing irregular. As the barrow delivers the seed nearer to the ground, it will, as a rule, distribute the grasses more evenly than the most practised sower by hand. But whichever method is adopted, there is a decided advantage in making two sowings. If the grasses and clovers are mixed together, half the quantity should be sown by passing up and down the land, and the other half by crossing the first sowing at right angles. When the grasses and clovers are sown separately, as is probably preferable, the grasses can be put in in one direction, and the clovers should cross them."

A horse-rake is the best implement for covering the seeds. "In its absence a light iron harrow will answer the purpose,—the lighter the better. What is wanted is that as many seeds as possible shall be just covered with soil, and no more. Grass seeds will germinate and become established when they are merely pressed upon the surface of the earth, provided that they are not consumed by birds or scorched under a hot sun. But many will not germinate at all at a greater depth than half an inch. Hence the necessity of a fine tilth and shallow sowing.

"The roller must promptly follow the harrow, and it makes a better and more certain finish to go over the ground twice in different directions with a roller of moderate weight than to accomplish the task at one stroke with a heavier implement. The importance of this part of the work will be made apparent if any spots are missed by the roller, for on those spots there will be no grass plants.

"A specially good plant may often be obtained by first rolling with the Cambridge or ring roller, then sowing the seed, and afterwards crossing the land once or twice with the ordinary smooth roller."

In former editions of "The Complete Grazier," mixtures of grass seeds were prescribed for permanent pasture under various conditions of soil and situation. In the light of the fuller knowledge acquired in recent years it is not deemed expedient to quote such prescriptions. The fact that in no two cases are the circumstances precisely similar, whilst in many instances they differ very widely, is sufficient to demonstrate the difficulty—it might be said, the impossibility—of devising prescriptions generally applicable. It is the seedsmen who have acquired the largest and the most varied experience under this head, and to a trustworthy seedsmen the farmer is recommended to submit his case. Failing this, he should learn what he usefully can from the experience of others in his immediate neighbourhood, particularly in circumstances as similar as possible to his own. In either case he will not omit to bring to bear upon the problem the fruits of his own practically-acquired knowledge.

**ROTATION GRASS-CROPS.**—By alternating grass with corn and root crops, especially in the case of soils upon which it is difficult to establish permanent grass, land may be profitably worked with less capital and at a reduced outlay for labour.

Apart, however, from the question of an unsuitable soil, there are other weighty reasons<sup>1</sup> for the adoption of a system of alternate husbandry. "Two-thirds of many farms might with advantage always be in artificial grass. A great saving would be effected in tillage operations, horseflesh, and labour. The land would break up at the end of the period in excellent condition, and full of clover roots as a store of nourishment for the succeeding grain crop. The custom of maintaining agricultural holdings that are either almost entirely arable, or almost entirely pastoral, has failed to meet the necessities of the time. What is needed is a combination of arable and pastoral husbandry, so that when corn does not pay and stock is profitable, or *vice versâ*, each occupier may obtain benefit from one branch of his business. The grazier would be profited in being able to winter his own stock instead of selling it to make a winter's manure for

<sup>1</sup> In his prize essay on "Permanent and Temporary Meadows and Pastures," Mons. H. Joulie, a leading French agriculturist, arrives at the following conclusions:—

"1st. That the cultivation of roots and cereals deprives the soil of nitrogen, whilst that of grass and leguminous plants, temporary or permanent, on the contrary, causes it to accumulate in the soil. That nitrogen being the most expensive manure to buy, it is not economical to devote part of the land permanently to arable and part to grass, for while the one uses up the nitrogen, the other accumulates it in excess. On the contrary, it is preferable to alternate on the same piece of land the cultivation of roots and cereals with that of grass leys, so as in a measure to repair by the second the loss of nitrogen which the first cause to the soil. By this means cultivation can be kept up indefinitely without purchased nitrogen, provided that the land be maintained in a fit state of richness as regards the mineral elements which are indispensable to healthy vegetation.

"2nd. The practical application of this principle is, that the temporary occupation of the land by a grass ley for two or three years, which takes its turn in the rotation of crops, should be preferred. We thus secure the improvement of the soil obtainable from the cultivation of Leguminosæ (clover, lucerne, vetches, &c.). But as this class of plant will not succeed on every soil, temporary "leys" with gramineous (grass) herbage ought to give, where leguminous plants do not succeed, analogous, if not equally good results, and so assist materially in solving the problem of producing cereal, root, and other crops with increasing economy."—Journal of the Royal Agricultural Society, vol. xviii. 2nd series, 1882, page 222.



the arable farmer. On the other hand, the arable farmer would not then, as now, be compelled to sell his stock immediately his roots were exhausted, or pay the grazier to summer the animals for him. When neither arable nor pastoral land yields a profit, the system has the merit of reducing expenses to a minimum.

“Great arable farms, without enough pasture to keep half-a-dozen cows, and large grazing farms that are wanting in sufficient arable land to grow straw and roots for winter consumption, should both be regarded as evils, demanding prompt rectification. The admirable system, pursued in Lancashire and in Scotland, of annually laying away in artificial grasses a proportion of each farm for a period of three or four years, is so successful that it is surprising the practice has not long since been adopted all over the country.<sup>1</sup> Instead of this, the sowing of broad clover alone is still the rule, and the admixture even of rye grass the exception. In comparatively few instances it is usual to sow with the clovers such heavy cropping varieties as rye-grass, foxtail, and timothy, without which the best results cannot be obtained from the alternate system.”

Temporary grass layers may remain down for one, two, three, four, or more years. They are “almost invariably sown with spring corn, and they require substantially the same treatment as permanent pastures, although, as the varieties of plants employed are strong growers, there is not quite the same necessity for extreme caution in preparing the land. A temporary pasture may, in a genial, showery summer, afford useful grazing for horned stock soon after the corn is cut; and as the grasses are robust and comparatively coarse, although none the less nourishing on that account, they will not be injured by the hoofs of the cattle. The rolling should be done in November, instead of waiting until spring. Supposing stock to be kept off the ground, and the autumn to prove warm and genial, it will sometimes be possible by the end of October to get a cut of useful green food.” During wet weather in autumn it is not wise to allow bullocks to roam over heavy land. Some farmers object to feeding off “seeds” in autumn by sheep, but the treading by sheep is superior to any other form of consolidation, the only precautions necessary being that the land should not be too wet, nor the plant too small.

“For one year’s ley the species employed must be restricted to those which yield a large and immediate return. Annual or Italian rye grass should form the basis of the mixture, and an addition of perennial rye grass is generally desirable, as also a very small quantity of cocksfoot. For grazing, broad clover is preferable to cow grass, and white clover is also a necessary constituent. But for hay, alsike should replace white clover. Trefoil is of doubtful value; upon many soils it is indigenous,

<sup>1</sup> On this point an Eastern Counties (English) farmer writes us:—

“Soil and climate are really answerable for short leys in other districts. In the eastern counties it is found more profitable to make short leys, as it is not easy to grow rye grass without injuring the prospects of the wheat crop, which follows. Our climate is not moist enough for grasses in rotation. We also find the expenses of cleaning the land after long leys too great, and the land is always more foul for it right through the rotation. We also find it is more likely to encourage clover sickness.”

and in some few cases objectionable; but there are many instances where a proportion of it is not only legitimate but necessary.

“For two years’ ley it is desirable to add timothy and to slightly increase the proportion of cocksfoot. Italian will prove preferable to annual rye grass, but the proportion must be diminished, and a larger quantity of perennial rye-grass should be substituted. Alsike and white clover should be more freely sown, and the weight of broad clover slightly reduced. A heavier total seeding is necessary to make a satisfactory two years’ ley than is required for a single season, and more regard should be paid to peculiarities of soil and to the special object in view.

“For three or four years’ ley it is necessary, besides retaining timothy, alsike, white clover, and perennial rye grass, to still include some Italian rye grass, broad clover, and trefoil for the sake of the first year’s produce, but on suitable soils the place of the rye grass may largely be taken by tall oat grass. The value of the hay is increased, and the pasture made more palatable to stock, by partially replacing cocksfoot with meadow fescue; and foxtail must also be introduced. When the ley is needed for pasturage, an addition of hard fescue will render good service by making the bottom grass dense, and the broad clover may then be supplemented with cow grass. On chalky soils either sainfoin or lucerne may be desirable, the former being usually sown. The total quantity of seed will approximate more nearly to that required for a permanent pasture, although the finer varieties will be omitted.

“A heavy dressing of cake-fed farm-yard manure applied towards the close of the year will pay well, as nothing stimulates artificial grasses so much. The fresher the manure when placed on the ground, and the less it has been allowed to ferment, the better the grass will thrive. The pasture needs bush-harrowing and rolling down early in spring before being laid in for hay. The first year’s crop will mainly consist of rye grasses and clovers, but the bottom of a three or four years’ ley may be expected to improve for at least two years, and the foxtail, timothy, cocksfoot, tall oat grass, and other plants, will increase in bulk in the third and fourth seasons.”

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## CHAPTER VI.

### ON HAY-MAKING.

**I**T is impossible to specify any precise period for cutting grass for hay, as so much depends upon its growth and maturity, or power of affording the best and most nourishing food, and the state of the weather. It is extremely detrimental to grass-crops to cut them too early. It will, however, receive equal injury, if it is allowed to stand

until it sheds its seed. The best time, therefore, for mowing meadows, is just when the herbage is about to come into flower; and with respect to other grass lands, this operation should be performed before the grass comes into full flower.

The very early or rich meadows, and highly manured upland pastures, in the neighbourhood of large towns and cities, are usually ready for mowing some time in June;<sup>1</sup> and all the meadows and pastures which may not be cut in that month should be mown in July. In the act of mowing, the great object is to cut the grass as close to the ground as possible, and perfectly level, without, however, touching the necks of the plants, or injuring the sward. It is thought that grass will not thrive well that is not mown perfectly level and close; and the loss in the crop of hay is very considerable, for "one inch at the bottom weighs more than several at the top;" and besides, it is more stimulating to the young shoots to cut the grass close, than it is to leave it long and uneven. While great care should be taken, therefore, to cut the grass close and level, the swathes should be pointed so as to leave scarcely any ridges under them. The work of mowing calls into action almost every muscle of the frame; it is, in fact, one of the most laborious and exhausting of all the agricultural operations which the farm-hand has to perform. Mowing machines are now so thoroughly effective, they do their work so cheaply as compared with manual labour, and cost comparatively so small a sum, that, except in the case of very small occupations, it is now scarcely excusable if they be not used. Water meadows, however, are still chiefly scythe-mown, the reason being that the surface is so broken up by the water carriers that it would be difficult, and often impossible, to put the mowing machine into the crop to any useful purpose.

In converting grass into hay, it is of essential importance to have a proper supply of hands ready for the work. In some districts, two or three, men or women, are reckoned to be sufficient to attend upon each mower, who, if he is an expert workman, can, under ordinary circumstances, cut from three-quarters of an acre to one acre per day.

In the county of Middlesex the allowance is five haymakers, of both sexes, including loaders, pitchers, stackers, &c., to one mower. The making of hay has been there brought to a degree of perfection altogether unequalled in any other part of the kingdom, and, as the Middlesex system is quoted far and wide, we here introduce Mr. Middleton's interesting account of it, as given in his "Corrected Report of the Agriculture of Middlesex."

"*First day.*—All the grass mown *before* nine o'clock in the morning is *tedded* (or spread), and great care taken thoroughly to shake every lump out of it, and to strew it evenly over all the ground. Soon after-

<sup>1</sup> If meadow be grown,  
Let meadow be mown.  
Plough early ye may,  
And then carry hay.

(June's Husbandry).—*Tusser.*

wards it is turned, with the same degree of care and attention; and if, from the number of hands, they are able to turn the whole again, they do so, or at least as much of it as they can, until twelve or one o'clock, at which time they dine. The first thing to be done after dinner is to rake it out into what are called single wind-rows,<sup>1</sup> and the last operation of this day is to put it into grass-cocks."

"*Second day.*—The business of this day commences with tedding all the grass that was mown the first day *after* nine o'clock, and all that was mown this day *before* nine o'clock. Next, the grass-cocks are to be well shaken out into staddles (or separate rows or patches) of five or six yards in diameter. If the crop should be so thin and light as to leave the spaces between the staddles rather large, such spaces must be immediately raked clean, and the raking mixed with the other hay, in order to its all drying of a uniform colour.

"The next work is to turn the staddles, and, after that, to turn the grass that was tedded in the first part of the morning once or twice in the manner described for the first day. This should all be done before twelve or one o'clock, so that the whole may lie to dry while the work-people are at dinner.

"After dinner, the first thing to be done is to rake the staddles into *double* wind-rows;<sup>2</sup> next, to rake the grass into *single* wind-rows; then the double wind-rows are put into bastard-cocks: and, lastly, the single wind-rows are put into grass-cocks. This completes the work of the second day.

"*Third day.*—The grass mown and not spread on the second day, and also that mown in the early part of this day, is first to be tedded in the morning; and then the grass-cocks are to be spread into staddles, as before, and the bastard-cocks into staddles of less extent. These lesser staddles, although last spread, are first turned; then those which were in grass-cocks; and next, the grass is turned once or twice before twelve or one o'clock, when the people go to dinner as usual. If the weather has proved sunny and fine, the hay, which was last night in bastard-cocks, will this afternoon be in a proper state to be carried;<sup>3</sup> but, if the weather should, on the contrary, have been cool and cloudy, no part of it, probably, will be fit to carry. In that case the first thing set about after dinner is to rake that which was in grass-cocks last night into double wind-rows, and then the grass which was this morning spread from the swaths into single wind-rows. After this the hay, which was last night in bastard-cocks, is made up in full-sized cocks, and care taken to rake the hay up clean, and also to put the rakings on the top of each cock. Next, the double wind-rows are put into bastard-cocks, and the single wind-rows into grass-cocks, as on the preceding days.

<sup>1</sup> That is, they all rake in such manner that each person makes a separate row, the rows being three or four feet apart.

<sup>2</sup> In doing which, every two persons rake the hay in opposite directions, or towards each other, and by that means form a row between them of double the size of a single wind-row. These double wind-rows are about six or eight feet distant from each other.

<sup>3</sup> It seldom happens, in dry weather, that it is not ready to be carried on the third day.

“*Fourth day.*—The great cocks just mentioned will usually be ready to be carried before dinner, but this depends on the weather. The other operations of the day are similar, and occur in the same order, as before described, and are to be continued daily until the hay-harvest is completed.

“In the course of hay-making the grass should, as much as possible, be protected both day and night, against rain and dew, by cocking. Care should also be taken to proportion the number of haymakers to that of the mowers, so that there may not be more grass in hand, at any one time, than can be fully managed. This proportion is usually about twenty hay-makers (of which number twelve may be women) to four mowers; the latter, are, however, sometimes taken half a day to assist the former: in hot, windy, or very dry weather, a greater proportion of hay-makers will be required than when the weather is cloudy and cool.

“It is particularly necessary to guard against spreading more hay than the number of hands can get into cocks the same day, or before rain. In showery and uncertain weather the grass may sometimes be suffered to lie three, four, or even five days in swath. But before it has laid long enough for the under side of the swath to become yellow (which will be the case if it is suffered to lie long), particular care should be taken to turn the swaths with the head of the rakes. In this case it will cure so much in about two days as only to require being teded a few hours, when the weather is fine, previous to its being put together and carried. In this manner hay may be made and stacked at a small expense, and of a good colour; but the tops and bottoms of the grass will be insufficiently separated by it.

“The Middlesex farmers are desirous of preserving the green colour of their hay as much as possible, though a lightish brown is of no disservice to it. Hay of a deep brown colour, occasioned by its being heated too much in the stack, is said to weaken the horses that eat it, by promoting an excess of urine, and consequently always sells at a reduced price.

“In the making of hay much depends upon the quality of the soil, and the kind of herbage growing on it. The hard, benty hay of a poor soil being in little or no danger of firing in the stack, may, therefore, be put very early together, in order to promote a considerable perspiration, this being the only means of imparting such a flavour to this hay as will make it agreeable to horses and lean cattle. It will be almost unfit for every other sort of stock.

“It is the succulent herbage of rich land, or land highly manured, that is most likely to generate sufficient heat to burst into flame, as it sometimes does. Therefore the grass from such land should have more time allowed in making it into hay. The Middlesex farmers are perfectly aware of this; and when the weather proves moderately drying, they make most excellent hay; but when very hot, or scorching, they, as well as most other farmers under similar circumstances, are sometimes mistaken. In such weather the grass becomes crisp, and rustles, and handles like hay before the sap is really sufficiently dissipated to render it fit to put into the large stacks. Where that is done,

when it is thus insufficiently made, it generally heats too much, sometimes becomes *mow-burnt*, and in other cases, although such are very rarely met with, spontaneous ignition takes place."

Since Middleton wrote the foregoing very accurate description of hay-making in Middlesex in the last century many new implements and machines have been invented to lessen the amount of manual labour required in the hay-field. It is doubtful, however, if there is any improvement in the quality of the hay, inasmuch as the methods which he recorded were perfect, and though machinery had very little place in the hayfield until the last quarter of a century no improvements were made in the meantime. In fact, where machinery is not freely used in that county, the process, as described by Middleton, is almost identical to this day, and it is quite safe to say that no finer hay is made under any circumstances. The mowing-machine has greatly superseded the scythe, and the large gangs of men who might have been seen tramping from the Midland counties to the "hay-country" (as the grass districts of Middlesex, Herts, and Essex were, and still are, called), with a scythe and fork over their shoulders, twenty years ago, have disappeared, and it would be almost impossible to obtain the hands required for the thorough working which the grass was subjected to under the system in vogue at that time. The general opinion as to the effect of the mode of cutting on the turf itself is that much less damage is done where the grass is cut off with the sharp edge of the scythe, than when partly crushed as well as cut by the machine; for this reason there are many who still spare no pains to secure sufficient scythemen to cut their grass.

The course pursued in making the best hay by means of the machinery now available is to cut it with the mower, and to keep the tedding-machine, or haymaker, at work immediately behind it, so that the cut herbage may at once be subjected to the influence of sun and wind. Should the atmosphere be very drying the material teded in the early morning should be teded again in the afternoon. On the second day an endeavour should be made to get it "in hand," that is, in such form that at the appearance of rain it may rapidly be run up into large cocks, in which it is safe. We are assuming that the process is carried out as far as possible by machinery, therefore the first operation will be to horse-rake it into rows, and the tedder should be set to work along the rows so as to throw them out into beds about 4 yards wide. From time to time the tedder should be made to repeat the operation, until the approach of evening, when the beds must be hacked into rows, and then run up into large cocks.

There are two important reasons for getting the grass into cocks: the first, to prevent injury from rain, and the second, to give the ground an opportunity to dry. It is impossible to make hay rapidly, or free from mouldy pieces, if the ground is not dry, and when the grass lies out over the entire area of the ground moisture is retained on the surface. Whilst the hay is being put into cocks, the horse-rake should be at work behind the men who are building them up, so that

no locks may be left strewn about, and before leaving the field at night everything should be tight and snug. On the third day the hay should not be thrown out until the dew is off the ground, and the first operation should be to roll over the cocks so that the ground on which they have stood gets a fair opportunity of drying. With this object in view they should be so turned that it may get the full benefit of the sun and wind, and not in the contrary direction, which would make the turned-over heap act as a shelter to the area which was to be dried. When as much hay has been turned over in this way as may be considered sufficient for the day's working, it should be thrown out roughly by hand, and the haymaker should be set to work to toss it into broad rows as on the previous day. It is a very grave error to throw out more than can be guarded in case rain comes on suddenly: it is safe when in the cock, and should remain there until a favourable opportunity arrives. During the morning it should be tedded up, and then, if the weather has been very fine and drying throughout the process, it may be got into wind-rows and carted. It is not necessary to cock it, as it picks up more easily from the rows if it has been "put in" well. A very efficient machine, which will be seen in the implement section (page 748), has for some time been used for picking up and putting the hay on to the carts, thereby making the process of haymaking less dependent on manual labour.

The process we have described is that which would be applicable in a period of fine weather. If the weather is not reliable, small quantities only should be exposed to risk at one and the same time. If the weather is dull but fine, and the grass does not dry fast enough to be fit to stack in three days, the only difference in the management is to extend the period during which the workings, *after* the grass has been got into broad beds, are carried out. It may even be necessary to put it in these broad hacks, and to cock it up, for several days and nights. The chief rule to observe, and it is one of great importance now that so much grass can be cut in a day, is to get no more on the ground than the staff at command can work. Grass may be injured by getting too old before cutting, but not nearly to so great an extent as when cut and left to the mercy of the rain for days together.

The foregoing details represent the best system of haymaking; but cocking is now uncommon in many districts. The grass is often allowed to lie as it was cut until made nearly through the swaths, and then, on a sunny day, it is turned by the swath-turner, or spread and aired by the haymaking machine, or treated first by the former, and a few hours later by the latter. After this, if well dried, it is loaded and stacked, or, if the weather seems settled, it is left to be dealt with on the next day. The hay-sweep depicted on page 749 supersedes carting where it is used, while the horse pitch-fork or the elevator saves much of the labour of stacking. Where there are plenty of waggons, hay may often be loaded when it cannot be stacked safely, remaining on the vehicles to sweat for a few days before it is stacked.

"The time for mowing," states Mr. Sutton, "varies in different localities, and in different seasons. But there are sound reasons for urging the importance of cutting the grass young, before even the earliest varieties have formed seeds in their flower-heads. Experiments made in the chemical laboratory prove that, although there are exceptions, the great majority of grasses contain nearly twice as much nutritive matter before, as they do after, the ripening of the seeds. This applies with especial force to the clovers which form so large a proportion of every good meadow. An objection to the early cutting of grass deserves a passing remark. It is quite true that young grass shrinks more than that of older growth. Still the balance is in favour of early mowing, for the hay is of higher quality and far more digestible, to say nothing of the advantage of an increased aftermath and the benefit conferred on the meadow by early cutting.

"Mowing machines have greatly altered the conditions of haymaking, and the change is not always in favour of the hay. There is the temptation referred to above to cut more grass than can be dealt with, and in wet seasons this may involve serious loss. And in a scorching time, when the grass becomes hay almost without any making, it will be so burnt up before it can be ricked as to render the fibres hard and woody."

The stems of grass are protected by a delicate bloom, a waxy secretion, which has been termed "Nature's waterproof mantle." Tossing the grass about breaks the stems. There is a rent in the "mantle" by which wet enters and decay is hastened. "Hence in continued wet weather the cut grass should be allowed to lie just as it is left by the scythe or mower, and it will then take the minimum of harm. In fine weather the tedding machine should be used much more freely than is commonly the case, for every time the machine goes over the ground a different series of grass stalks are exposed to the sun. Often, when the end of a field is reached, the beginning is ready for a fresh start, and it is a mistake to suppose that because scorched grass makes bad hay, therefore quickly made hay resembles scorched grass. These remarks are intended to apply exclusively to meadow hay. Clovers, sainfoin, &c., should be turned in the swath by hand, and with the utmost care, to avoid breaking off the leaves."

When a particular field is ready, the whole strength of the farm should be concentrated on the labour of gathering and carting the hay to the rick. Mr. Sutton remarks that he has known a crop of grass cut one morning and stacked at night; but the crop was light, the heat unusual, and the desiccation of the plant had considerably advanced before the mower was used. Still he is persuaded that in hot weather grass might often with advantage be put into wind-rows or cocks on the day it is cut, although it is seldom done. "Dew is well-nigh as injurious as rain to half-made hay, and grass which has parted with much of its water on a hot summer day is in a condition to re-absorb moisture from the atmosphere at night. This process goes on much more rapidly when the hay lies scattered on the ground than when it is cocked. The cocks should not be opened too early in the



morning, and if the sun prove hot it will spoil the colour to scatter the grass very much. Greenness is one of the indications of well-made hay, while a brown shade, whether resulting from rain or sun-burning, is a certain sign of deteriorated condition. Three days ought to suffice to make good hay in fair weather from an ordinary crop. Grass which is cut one day, tedded repeatedly the next, cocked that night, and opened out again on the following morning, may be fit to carry in the afternoon of that—the third—day. A very heavy crop, however, or a crop in which there is an unusual proportion of clover, must not be ricked so quickly, nor must it be left too thin on the ground. Succulent grass, with large solid stems full of moisture, is least easy to turn into hay, and is most liable to fire when ricked. The leaves and smaller shoots become ready to carry before the succulent stems, and this danger is often greatest in fine weather. Those who have had experience with water-meadows are aware of the extreme hazard of carrying hay from them too soon. An old and safe test of fitness is to gather together a few of the stout stems and twist them tightly into a rope. If moisture exudes, the grass is not ready for the rick. Clover stems, cow grass especially, also contain a large amount of moisture, and if ricked too soon there is a risk of the temperature rising injuriously. The use of the haymaking machine must be avoided entirely when clover forms a large proportion of the crop.

“Dry and benty grass which does not contain much clover will almost ‘make itself’ in fine weather, and but little fear need be entertained that it will fire. Indeed, if the rick does not heat somewhat the hay will be of inferior quality.

“‘Weathered’ hay—that is, hay which has been repeatedly soaked and dried until much of its value has been lost—will be improved in quality and made much more palatable to stock by sprinkling coarse salt over the layers of the rick as the building proceeds. From ten to twenty pounds of salt should be used for each ton of hay.

“After grass is cut for hay, it parts with nearly three-fourths of its weight by evaporation, but no chemical change of importance occurs in the field. In the rick, however, very considerable chemical reactions take place, such as the creation of sugar by the action of heat on the starch contained in the grass. The difference between good and bad hay nearly as often results from too little or too great heat being evolved in the stack, as from faults in the process before stacking. Overheating, even when it does not go so far as to blacken and char the hay, produces so much acetic acid as to make the fodder sour and unpalatable. Dr. Thompson showed that 387½ pounds of grass are required to make 100 pounds of hay. The loss is chiefly water, but not entirely so, as is demonstrated by the fact that an animal which thrives on 100 pounds of grass will not do nearly so well on 25 pounds of hay supplemented with 75 pounds of water. The loss of nutritious ingredients is of course attributable to the process of fermentation carried on in the stack. The sugar has

been largely converted into alcohol and carbonic acid, by which a certain amount of waste has occurred."

Before we dismiss this subject, we would call the attention of the farmer to some details of management that might otherwise possibly escape him, amid the multiplicity of his engagements. His store-cattle should be turned into the meadow for a few days immediately after the hay is cleared out of it, in order "to pick about the hedges," as it is termed in West Devon, for the herbage which, though then succulent and edible to the store cattle, would, before the after-grass was ready to be pastured off, become unpalatable, and be altogether rejected by young cows or fattening stock, with fresh succulent herbage before them. Such cattle must not, however, be continued on the newly-mown land after they have effected the object for which they were placed there.

Various modes are practised in order to make the most of the AFTER-GRASS or *aftermath*, *rowen*, *fog*, or *eddish*—for by all these names is the second crop designated—which is in much request for cows. In the vicinity of large towns, or where lambs are suckled to any great extent, it may be advantageous to take a second crop of hay, in the mowing of which, however, more attention is necessary than in the previous case, owing to the greater difficulty of cutting the grass crops on account of their lightness. Hence, unless the mowers are very skilful, the scythe is apt to pass over the grass without fairly cutting it. The proper time for taking this second crop is as soon as there is a sufficient length of rowen to cut; and the operation of mowing should be performed early in the morning, before the sun can have evaporated the dew.

The subsequent procedure varies in no respect from that followed in preparing the first crop of hay. Less time, however, will suffice: but rowen hay should be well made and preserved, otherwise it will become mildewed or mouldy, and be rejected by the cattle.

The hay from the eddish or after-grass of water meadows is inferior to that of upland meadows; and the grass not having had sufficient sun or time to harden it, is soft and woolly, and *has no proof in it*. Cattle, though fond of it, do not thrive upon it; still, it is used chiefly for cows. On this account, therefore, it will be advisable to turn the neat cattle into the eddish of water meadows, and to retain the aftermath of other grass lands for the trying season of spring; for when other kinds of fodder are scarce, the rowen will prove not only a most seasonable supply for ewes and lambs, but is said to be far preferable for them to turnips, cabbage, &c. The rowen is never so good as the first crop, either in quantity or quality; in addition to which, the late period of the season renders the preparation of it precarious and difficult. It is, therefore, good husbandry, except under the particular circumstances to which reference has been made, to pasture the aftermath, and not to make it into hay. Low says, "Wherever the system of cultivated grasses is perfectly understood, they will never be mown for hay more than once, and then the after-math used for herbage

only." As a matter of practice, it is not usual to take more than one hay crop a year off water meadows. In the counties of Wilts and Hants, where water meadow husbandry is largely pursued, the "meads" are "flooded" or "drowned" once or twice after the hay crop has been carried off, and the aftermath is grazed either by cattle, or by farm horses, or by both, till far into the autumn. The "meadman" is meanwhile engaged in cleaning out the water-carriers, trimming their banks, &c., and the meads are periodically flooded throughout the winter. By the middle or end of March they carry a fair amount of herbage, on which sheep are hurdled throughout April. Subsequently the meads get two or three floodings, which stimulate rapid growth, and the cutting of the hay crop commences about the end of June. Sheep are not allowed to graze the water meadows in autumn, lest they should succumb to the liver fluke, the attacks of which are not to be feared after the cold of winter.

If after-grass is consumed in the usual way by grazing shortly after the fields are cleared of hay, or in autumn, its value will be small, unless in the case of water meadows, on account of the abundance of food usually prevailing at that season; but when kept for ewes and lambs, and other stock, in the depth of winter and the trying season of spring, when food is scarce, it becomes of the greatest value.

The making of aftermath hay is not by any means general, and is always precarious. The autumnal dews and shortening days, combined with the succulent nature of the herbage, are all against it. But as many of the late-growing grasses, of which the herbage principally consists, are specially nutritious, there is a prevalent opinion that the lattermath is of higher quality than the first cut. In adverse weather it is advisable, after mowing the aftermath, to convert it into silage.

The old Welsh system of "fogging," or allowing the hay crop to cure itself, uncut, in the open fields, is contrary to all the principles on which grass land is managed in other parts of the country.

Having stated in the preceding part of this work the most useful modes of consuming the after-grass, we have only to add a word or two as to the time proper for shutting it up for use during the following winter and spring. This depends on the character of the soil. Land of moderate fertility should be shut up immediately after it has been mown; but in fields of greater luxuriance, August is a better month, and still richer lands need not be closed until September.

## CHAPTER VII.

## ON STACKING HAY.

THERE is great difference of opinion among agriculturists respecting the relative advantages of stacking hay and housing it in barns, and the method followed in each locality is usually determined by climate and situation. In Lancashire, and other northern counties, *hay-barns* have been erected on pillars, and covered with slates. The floors of some of them are boarded with loose planks, perforated with holes, and lying hollow for a certain space above the ground, for the purpose of admitting a free circulation of air beneath. These buildings are cheap, useful, and very convenient; in the dry season they save much litter and waste, and in wet seasons the advantage afforded by them of quickly securing the hay will often prove of no slight pecuniary importance to the farmer. Besides, they admit of the hay being cut, weighed, and bound, during bad weather, none of which operations could then be performed without shelter. Experience has proved that the quality of hay is improved by moderate *sweating in the stack*; and it will generally be found to be preserved sweeter in stacks than in close barns. A barn, however, consisting merely of a floor and roof supported by posts, and open at the sides, will be found exceedingly useful. This is commonly called a Dutch barn, and has come much into vogue since the introduction of light corrugated iron roofing. When this is not available, rick-cloths and poles should always be used while the stack is forming, in order to preserve it from rain until thatched.

Although a slight degree of fermentation or *sweating*, as the farmer calls it, always takes place, both before and after the hay is stacked, its taste and nutritive quality being thereby improved, great care must be taken that the process is not carried too far, or the result may be the heating and firing of the rick. Even if the fermentation does not proceed to such an extent, the nutritive properties of the hay will be much lessened. Some of it obtains a sweet sugary taste, and is eaten greedily by horses and cattle, but it is too apt to produce disease of the urinary organs, and, occasionally, lays the foundation of some fatal malady. The colour of the hay changes to dark-brown, and it becomes altered in texture. It is as short and brittle as rotten wood, and has a disagreeable taste. Another portion, perhaps, becomes mouldy, stinking, and thoroughly rotten.

One objection to mow-burnt hay is that it does almost irreparable harm before its dangerous effects are suspected. The animal will eat greedily of it at first, but, in the course of a little time, he begins to be disgusted, not only with it, but with all other food, and becomes hide-bound and emaciated. Cattle are less injured by it than horses, but it

ought not to be given to any animals. An admixture of salt may correct its bad properties to a certain extent—but, as a matter of prudence, it should be used in small quantities at a time, to give an aromatic flavour to other hay which is not particularly palatable.

The square or oblong forms of stack are most convenient, as the hay can be more easily cut from them, either to form trusses for the market or for consumption, care being taken to cut it off perpendicularly and on the opposite quarter to that whence most bad weather may be expected; they also admit the air more fully. Whatever their shape, they should be so formed as to spread gradually outwards as they ascend, such a mode of formation tending more effectually to secure them against moisture, and requiring less framework than when they are built up square from the bottom. When the bottom of the stack is thus shorter and narrower than the eaves, the rain falling from the thatch will clear the sides of the rick. “The roof must be steep enough to shoot off rain and snow, but it injures the upper portion of the hay to go higher. Roughly stated, the top of the rick measured across under the eaves should be about one and a half or two feet more than from the eave to the ridge. This gives almost an equilateral triangle.

“Ricks may occasionally be seen standing on the bare ground where floods are not unknown. It is unwise to erect them on such spots, for they absorb moisture almost as readily as a lump of sugar placed in water. Some injury will probably ensue from the damp ground, and the whole bulk of hay may be made mouldy by a flood.” The resort to stone or iron saddles will often pay even in a single year. Faggots of wood form a sweet and efficient foundation.

“Rick-cloths cost money, but they are of great service in protecting partially made ricks when hay-carting is suddenly interrupted by rain. Indeed, rick-cloths save all anxiety about thatching, for the task can be deferred until the stack has settled, and it is consequently safe to put the roof on.

“The practice of making ventilating shafts in the centre of a rick by pulling up a sackful of hay as the work proceeds need only be resorted to in catching weather, when it is impossible to put the hay together in first-rate order. No doubt the contrivance has prevented many ricks from firing, but it restricts the partial fermentation which takes place in a solid stack, and this is an important influence in the production of a fragrant sample of hay. A much better method of treating grass about the dryness of which there is a doubt, is to place layers of dry straw between thicker layers of hay. The straw will absorb the excessive moisture, and with it many of the valuable juices of the clovers, which will greatly enhance the feeding value. This plan is not available for hay which is intended to be sold, but it will make capital fodder for home consumption.”

Coarse grasses, as well as sedges and rushes, are sometimes used for thatching, and a saving of straw is thereby effected. One of the commonest materials employed for this purpose is the largest British species of grass, the great reed (*Phragmites communis*), which grows

luxuriantly on river-sides, where its purple panicles form conspicuous objects in August and September. In some localities it is known as "spear grass," though this term may be taken to include the reed canary grass (*Phalaris arundinacea*) and the sedges (*Carex*), which grow with the great reed beside the streams. This coarse material, cut and dried, makes serviceable thatch.

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## CHAPTER VIII.

### ON ENSILAGE.

THE advantage of possessing succulent food for winter consumption has been recognised at all times, but it has been found difficult to secure. A portion of the root crop has, as a rule, been given to the cattle in the yards, but no convenient and cheap method of preserving surplus herbage, grown during seasons of plenty, for consumption when food was scarce, had been brought into practice in England until after the year 1880. Before that year, and indeed for two or three years subsequently, scarcely any English farmers had seen a sample of silage, yet in less than ten years from the time of the first experiment the system of making silage had become an established and even a common practice on the farm. The uncertainty of the British climate renders the making of good hay very difficult, and in some seasons impracticable; therefore, any additional means of retaining the feeding properties in grasses and other forage plants, and at the same time not destroying their succulence, is of great value. This can be satisfactorily effected by the process of ensilage. As the making of silage is an ancient practice which has been maintained in some countries for centuries, and as Englishmen have long been in the habit of ensiling grains in summer-time for winter consumption, it is strange that, as the hay crop was so frequently ruined by wet weather, the practice did not earlier obtain a place among the methods of English farmers. Although ensilage was adopted on a considerable scale in France and North America during the latter part of the seventies, Englishmen remained sceptical as to its value, and classed it with other theoretical ideas such as are often suggested to the farmer and frequently prove useless.

There was a special excuse for not adopting the practice of ensilage, as, after great expense in bringing out machinery and making elaborate experiments therewith, an equally lauded process for preserving unmade hay in stacks, by drawing out the moisture by means of exhaust fans, had quite recently been proved to be worthless. The two processes of ensilage and of exhausting air by means of the fan were totally opposed, for in the former the effort was to exclude air, and in the latter to

draw off the moist heated air and to introduce a fresh supply. As the introduction of fresh air to an already fermenting mass supplies it with the oxygen necessary to feed the ferment, it is easy to understand that the principle is wrong, and that failure was inevitable. After several stacks, and the machinery used upon them, had been destroyed by fire, the exhaust fan system died out, leaving behind it a prejudice against new notions.

But the process of excluding air rested on a sound basis, and the few who were bold enough to experiment in this direction were rewarded with success. New converts were made, and, though the opposition was great, even from those who were accredited with being in the best position for estimating the value of the process, yet in a few years it emerged from the experimental stage, and became an established farm practice. The earlier English literature of ensilage shows that there were many misconceptions as to the principles, as well as errors in the practice, and these militated against its popularity. It was considered absolutely necessary that the silo, or receptacle for the green herbage, should be in the form of an air-tight chamber, for it was supposed that were any air allowed to enter the silo the whole of the contents would be injured. It was also thought that, as vertical pressure must be applied, there would be a corresponding lateral bulge; and so great was this lateral pressure imagined to be that it was supposed that ordinary walls would be deficient in strength to resist it. As a means of ensuring the necessary resistance it was considered that underground chambers would be most economical. Hence, the earlier silos were made underground. In some cases pits were dug purposely, and in others advantage was taken of those already in existence, such as chalk-pits.

Again, as it was thought that very great pressure was necessary, expensive methods of applying weight were used. It was also regarded as imperative that the material to be ensiled should be chaffed. It was further deemed necessary that the silage should be made in wet weather, and it was considered that ensiling was only a means of saving fodder which would be otherwise wasted. There were, moreover, doubts as to the safety of feeding animals on silage. All these objections have, however, disappeared.

It is not indispensable that an air-tight chamber should be used, although such a silo is most perfect, notwithstanding that the packing at the sides requires great care. No silos are in reality absolutely air-tight, except those made on principles similar to the silos of Mr. Whitehead, of Paddockhurst, Sussex, who devised circular chambers, built of brick, partly above, and partly below ground. They are made about twenty feet in depth, and are covered with an iron dome-shaped top, with a small opening in the middle for the purpose of filling. The opening is closed by an iron plate which is screwed down into a bed lined with india-rubber, so as to ensure a perfectly air-tight condition. The silo can also be filled at side doors, which are likewise made air-tight by being bedded in india-rubber; these doors are convenient for emptying the silo. The herbage is chaffed so as to pack in more

closely, and during the filling is well trodden. Absolute freedom from mould results, because the oxygen in the air which is imprisoned is converted into carbonic acid by the oxidation of a portion of the carbonaceous matter present. Water joints have been used, but as the water evaporates they are not so reliable as rubber joints. This is the most perfect system of ensiling, but the expense of erecting such a building is considered too great for ordinary practice, and it is seldom adopted. Many of the so-called air-tight silos were not so in reality, for, though there was no escape of air from the bottom or sides, the top was rarely made absolutely air-tight. Indeed, as planking was used, and as the planks seldom fitted closely, evaporation took place. This want of air-tightness in the ordinary brick silo was not of great importance, for it only affected the top layer, and, as will subsequently be explained, some waste is almost inevitable. If an absolutely air-tight covering of loose boards could be obtained, such a silo as is being described would be hermetically sealed, and a perfect silo would result. But this is impossible, and the advantages of a brick silo are only proportionately greater than those of an open-air stack.

The expense of digging out a pit and lining it with brick, or of building an above-ground silo with walls of extra thickness, has been proved to be unnecessary, as instead of the walls being bulged by the contents, it is almost impossible to pack the silage at the sides so closely that air is excluded. This is due to the shrinkage of the material during fermentation, for the mass always contracts towards the centre, thus leaving a space between it and the walls. This space admits air, so that a certain portion of the silage becomes mouldy, though it is less in proportion in the case of chaffed silage than in that of long silage. If enclosed silos are made, it is advisable to take advantage of natural or artificial circumstances, whereby hollows may be utilised, as the green stuff has to be lifted to a less height, and this diminishes the cost of the filling. Chalk-pits and other excavations may be usefully adapted, especially if on sloping ground.

When the process of ensilage was first introduced it was thought necessary to apply great weight to control the temperature of the mass, and to convert the material into silage, and a weight of as much as 200 lb. per square foot was applied in many cases. It is now recognised that the upper portion supplies sufficient weight to the lower, and that the only part which may be wasted by insufficient weighting is that immediately on the surface. The appreciation of this fact has led to the adoption of totally different methods of making silage, and renders open air ensiling practicable. It is especially taken advantage of in making the rough and ready stack known as the clamp, which is put together on the principle of the "drawn-up" dung-hill. The practice of chaffing the material has some relation to the principle of weighting, for the chaffed herbage packs more closely at first than does the unchaffed, and less weight is required to keep it near to the walls. Whilst there are these advantages in the practice of chaffing, on the other hand must be considered the important fact that labour is required, at the busy season of gathering in the crops,



which can be better spared during the slacker time of feeding the silage, in winter. Besides this it is no longer found necessary to feed the silage in a chaffed form, and it is now more generally fed in the long condition, as rack-meat. A comparison of samples of silage made under similar conditions, except with respect to chaffing, will show that the chaffed is greener in colour than the unchaffed. This is a proof that pressure has a more immediate effect on the chaffed material, and that the latter is consolidated more quickly, thus causing the fermentation to be brought about at a lower temperature.

This brings us to the question of sweet and sour silage. If an open-air silage stack is viewed in section from top to bottom, the lower layers will be seen to be greener than the upper, gradually becoming browner towards the top, which, under a small layer of dirty mould, will be of almost a burnt coffee colour. The bottom layers have been converted into green or sour silage, because the pressure of the material above has excluded the air, and a low temperature fermentation has taken place, there not having been sufficient air to supply the oxygen for a high temperature fermentation. As less weight was applied to the upper portion there was a *freer* access of air to it, and more air retained among the mass,—hence a higher fermentation. The colour thus affords an indication of the temperature at which the fermentation took place. It is generally recognised that silage made at a temperature below 120° F. is sour silage, whilst that which has not risen above 90° F. is commonly spoken of as low-temperature sour, and that which has exceeded 90° F. as high-temperature sour. Between 120° and 130° there are generally veins or seams of sweet and sour silage. From 130° to 140° a shade of brown is discernible. Between 140° and 160° it is decidedly brown; and above 160° it is over-heated, and very similar in appearance to over-heated hay, whilst the flavour denotes burning. It was supposed that, when the temperature of fermentation exceeded 123°, no acids would be present; but, in the experiments carried out at Bristol for the Bath and West of England Society this was not found to be correct, for, though the greatest care was taken in the manufacture of the various kinds at different temperatures, acids were present in all. Another practical result was obtained from these experiments in determining the loss of weight by evaporation and otherwise: 50 cwt. of grass was dealt with in each case, and the respective losses are shown in the following table:—

	cwt.	qrs.	lb.	
1. Sour Silage (long)	4	2	5½ = 9·10	per cent. (weighted with 200 lb. per sq. ft.)
2. Sour Silage (long)	4	2	15¼ = 9·28	„ „ 100 „ „
3. Sweet Silage (long)	9	0	22 = 18·40	„ (ensiled at once)
4. Sweet Silage (long)	30	1	6 = 60·61	„ (dried 24 hours in hot sun before making)
5. Sour Silage (chopped)	2	1	0 = 4·50	„
6. Sweet Silage (chopped)	4	3	22 = 9·89	„
7. Hay	36	3	26 = 73·97	„

The great variation in the loss shows that samples of silage made under different circumstances with regard to heat had dissimilar values, especially in the case where the grass was allowed to wither before

being put into the silo, and this must always be taken into consideration when fixing the value. The high temperature necessary for the production of sweet silage is sufficient to destroy the living organisms which, at a lower temperature, produce an acid fermentation. It may be explained that the sweet silage made from fresh grass has a vinous smell, and is called the fruity type of sweet silage, whilst that made from withered grass is called aromatic, also on account of its odour.

The advantages and disadvantages pertaining respectively to sweet and sour silage are briefly as follows. Sour silage contains the largest amount of feeding matter because the carbo-hydrates have not been so much destroyed or consumed during fermentation. The rise in temperature of the sweet silage is due to the oxidation, and therefore to the waste, of carbonaceous matter. Sour silage possesses a strong odour which is generally considered unpleasant, and which certainly has a prejudicial effect on the flavour of milk brought within its influence. Sweet silage possesses no unpleasant odours, and can be safely introduced among dairy cattle.

Ensilage can be practised in all weathers, and it is regarded as a desirable means of preserving a portion of the green crop, and not merely as a method of saving that which would be wasted if treated in any other manner. The doubt which once arose as to the safety of feeding animals with it no longer exists. It is now recognised to be specially valuable as a food for dairy cows, as it stimulates the flow of the milk. As there is some danger of the milk becoming tainted with the odour of the silage, none of this product should be allowed to lie about the cowsheds, and only so much should be given to the cows as they will promptly and entirely eat up; the feedings should be given as soon after milking as possible. Silage is one of the safest foods for sheep, and is extremely valuable for in-lamb and freshly-lambled ewes. Summers of plenty are not always followed by winters of abundant growth, and in those seasons when roots are destroyed by frost nothing proves of greater service to the flock-master than a good store of silage to fall back upon. In all probability silage will be much more extensively used by flock-masters in the future than has hitherto been the case.

Almost any green herbage may be converted into useful silage. Unless, however, the material possesses a considerable amount of feeding matter it is impossible that the silage should be of great value. The greater portion of the feeding properties may be retained, but they are not augmented by the process of ensilage.

The making of silage in a silo is much more simple than the making of hay. There is, indeed, but little to learn, as it can be made regardless of weather, and practically all there is to do is to get the material into the silo and weight it. A few precautions are necessary, such, for instance, as shaking out the material evenly, not letting it lie in large locks, and being careful to keep the sides well packed, so that there is as little space as possible between the walls and the material. The middle of the mass will cure itself, and requires but scant attention, almost the whole of the care having to be bestowed upon the outsides,

for it is there that waste takes place. It will be found that mould forms near the surface within three days; therefore, when making silage, fresh material should be added at least every three days until the silo is finally closed. The weight may be applied in any way that is found most convenient, according to local circumstances. Earth, stones, pig-iron, and other materials have been successfully used, but it is now most common to adopt one of the mechanical methods specially made for compressing silage, illustrations of which will be found (page 754) in the section of this work devoted to implements.

The great increase in the popularity of ensilage some years ago was largely due to the progress made in the open-air or stack method of making silage. No expensive outlay is required, and the slightest preparations are sufficient to enable a start to be made. Hence, when the farmer finds that haymaking is impossible, he can, without loss of time, commence gathering his crop together and convert it into silage. The most simple of all systems is the making of a silage clamp, which is a heap formed on the same plan as the drawn-up dung-hill. The rules which apply to the proper manufacture of silage in the silage clamp are applicable more or less to the making of silage in the silo, or silage stack, and afford a guide as to what should be observed and what avoided. Practice has shown that the following rules should be followed in making the silage clamp.

Grass should be mown as soon as, or before, the majority of the grasses are in bloom; clover when the whole crop is in flower; peas and vetches just when the pods are forming, but before they commence filling; oats and other cereals when the grain commences to form; and rough trimmings from banks and ditches at any convenient time, but as these are not very valuable it is advisable to cut them when they may be used to form the top layer. In selecting a place for the clamps, advantage should be taken of hill-sides, so that the drawing-up tongue may be as shallow as possible, thereby lessening the quantity which will require turning up when finishing the clamp. It is best to cart immediately behind the scythe, unless the material is exceptionally succulent, as in the case of sewage-grown grass: the weight of the material thus helps to ensile that below it. The herbage should be carted together in such a way that the horses and carts cross it, thus consolidating it, and a roller drawn by one or more horses should be used to press it down, and make it more easy for horses to cart over. The carts, roller, and horses would not afford sufficient weight to compress the mass at once into the solid condition in which it comes out as silage, and which weighs from 50 to 60 lb. per cubic foot. But when fermentation takes place the fibre in the material softens, and readily submits to compression. It has already been stated that mould forms if fresh material is not added within three days, so that no time exceeding this should be allowed to pass without fresh supplies being brought. This point must also be considered with reference to the sides, which should be kept hand-pulled, or pared daily, otherwise the portion taken off the sides will be in a mouldy condition when put on the top.

In constructing the clamp the greatest care must be taken to keep the sides upright, and they should receive additional rolling on the top in order that they may be properly compressed. The carts should be led round as near the sides as possible for the same reason. It will be found necessary to maintain the sides higher than the middle, as it is impossible otherwise to keep the stack in proper shape. When all the material has been brought to the clamp the tongue should be turned up so as to ensure that the whole of the top shall be of uniform height when it has settled. The clamp should be covered as soon as possible, for less waste will result than when it is allowed to become dried on the top. If during intervals of making, the surface dries, it should be well watered, in order that an even sample may result. As to weighting, it is a common practice to build a haystack on the top of the silage to provide the pressure required, and this answers admirably. As there is waste at the sides of all silage, it is advisable to build large stacks or silos so that the extent of the sides may be proportionately lessened. If care is taken to pack the material close to the walls, the loss is considerably less in the case of silage made in silos than when it is made in the stack, therefore small quantities are more permissible in the silo than in the stack. Silage may be fed to cattle at any time it may be required after it is once put together. It will keep good for years if well secured.

When ensilage was first practised it was urged by enthusiasts that silage would be found to be a complete food like grass, and that it would be possible to fatten beasts on it alone. Experience has shown that this is only partly true, but that silage is very valuable when forming a portion of a diet. It then takes the place of roots in virtue of its succulence, and at the same time affords some of the nutritive qualities of hay. Its feeding value is superior to that of roots, a ton of silage being worth more than a ton of roots. The value of a ton of silage may, however, vary greatly,—first, from the kind and quality of the material of which it is composed; secondly, from the amount of moisture in it; thirdly, as to its condition, as denoted by freedom from mould and from over-burned portions.

As a means of preserving green crops which might otherwise be wasted, and of securing most of the succulence and feeding properties of summer-grown crops for winter consumption, silage is found to answer admirably. Still, in this country, predictions as to the increased practice of the system have not been verified. On the contrary, it has been very little used in recent years. This is all the more curious in the face of the fact that ensilage has continued to grow in popularity in the United States and some of our Colonies.

## CHAPTER IX.

## ON IMPEDIMENTS TO THE SCYTHE, AND ON THE ERADICATION OF WEEDS.

GRASS lands are sometimes burdened with various obstructions, which claim the attention of the industrious farmer.

I. ANT-HILLS are very detrimental to pastures, not only by wasting the space which they occupy, but by obstructing the free use of the mowing-machine. The ant-hills are unsightly and injurious, and there is great difficulty in driving the insects from the habitations which they have so carefully constructed. The common mode of removing these excrescences consists in dividing them into four parts from the top, and afterwards digging sufficiently deeply to take out the core below; so that, when the turf is replaced, it may be somewhat lower than the level of the rest of the soil, and thus, by rendering this spot moister than the neighbouring parts, prevent the ants from returning to their former haunt.

Whatever method may be adopted for removing such obstructions, the work should be performed in November, or during some part of the winter; because if the places or spots are then left open and exposed, the frost and succeeding rains will exterminate all ants that may remain in the lower part of the habitation. A contrary practice, however, has been recommended by some farmers, viz., the destruction of ant-hills in the month of April, on account of the advantage of immediately sowing grass-seeds on the spot. For this purpose a dressing of manure, in which chalk has been mixed, is recommended to be thrown over it, as tending greatly to accelerate the growth of the seeds.

II. MOLE-HILLS.—Mole-hills should be thrown down by means of a spade, or grass-harrow; but it is preferable to trap the moles, and thus prevent the formation of molehills.

III. STONES are sometimes so firmly fixed in the soil that they cannot be removed without considerable difficulty; but when they are found in a loose state on the surface of the land, and are likely to impede the mower, they should be picked off. This should be done in the month of March.

“The presence of stones, corks, and other hard rubbish which may have been deposited by previous dressings, not only diminishes the crop while growing, but will by-and-by make it necessary to set the machine high enough to avoid breakage. Now the mower should always be set as low as possible, for the bottom herbage is, weight for

weight, more valuable than the top, and every inch of the former counts both in weight and in quality. The clearing of stones from the field is therefore worth scrupulous attention, and it should be done before the grass makes a start in early spring. The turf must also be well harrowed and firmly rolled down."

IV. WEEDS.—Under this denomination are included all those plants which flourish spontaneously, to the detriment of the plants that rightly constitute the crop, and to the consequent loss of the farmer. As they thrive without care, and even in spite of the efforts made to suppress them, it is evident that they are of a more hardy and vigorous nature than the plants which require the fostering hand of man, and will, therefore, always be apt to obtain the superiority, and to appropriate to themselves every kind of plant food. The yield of the crops will be diminished in proportion to the prevalence of weeds; and hence it is of the utmost importance to prevent, as far as possible, the growth of every kind of vegetation except that which is the direct object of cultivation.

Weeds are *annual*, *biennial*, or *perennial*. The first-named spring up from seed, and produce their flowers, fruit, and seed, and die all in the same year. *Biennials* complete their vegetative growth during the first year, and develop flower, fruit, and seed in the second year. Both annuals and biennials are dependent, therefore, upon seed for their perpetuation. *Perennial* weeds are such as continue several years, being not only propagated by their seeds, but also by their roots, which lie in the ground during the winter, and put forth new shoots in the spring. It is from perennial weeds that grass land is most liable to suffer.

Some seeds germinate as soon as they obtain moisture, and although they may not be in immediate contact with the earth, thrust down their roots to its surface. Many seeds, even those of the most diminutive size, may remain dormant for a long series of years, and then vegetate as soon as any accident has placed them in a favourable situation. To this vitality of seeds may be attributed the spontaneous appearance of weeds in abundance upon land supposed to be free from them; deeper ploughing may have brought to the surface seeds which, though they have long remained dormant, are not dead.

Seeds are often furnished with some appendage, by means of which they are conveyed from the place of their origin, and disseminated over the fields. Thus the dock seeds are contained in wing-like coverings by which they are sometimes carried, in a high wind, to a very considerable distance; other seeds are surrounded by a light glume or husk, like a mantle; while the buoyant plumes of the sow-thistle, bur-thistle, coltsfoot, and similar compositaceous weeds float them through the atmosphere to remote places.

On account of the different characters of weeds, it is obvious that different means of extirpation are required. Annual and biennial plants may be destroyed by pulling them up by the roots, or by dividing the stem beneath the lowest or first-formed leaves, or—

after they have begun to flower—by cutting them anywhere below the lowest branches.

It is not to be expected that land can be freed from weeds by extirpating those which spring up in one year; these have been propagated by former plants that have shed their seeds on the ground, and many of these seeds, if not in a situation favourable to germination, may lie dormant for years, and then shoot up.

Perennial roots cannot be destroyed, except by pulling them out of the ground, and either carrying them away, or exposing them to the air until they become dry and dead. As, however, this can only be thoroughly effected by the plough, perennial weeds cannot be completely eradicated out of grass land, but only checked to a greater or less degree. As the roots are unable to thrive without the leaves, these plants may be considerably discouraged by repeatedly depriving them, during the season of growth, of their leaves and stems. Cutting them through the stems about the middle of June, or when the weeds are in full vigour, and before they mature their seed, will tend considerably to diminish their future growth.

When perennials have once been allowed to get full possession of the soil, a summer fallow is the only remedy.

The COMMON DOCK (*Rumex pratensis* and *Rumex crispus*, L., nat. ord. Polygonacæ) is too well known to require any description; it is a most troublesome plant. On grass land it should be completely drawn out of the ground with the docking-iron as soon as the flowering-stem is formed. As the plants rise at two seasons, the fields should be weeded twice in the summer, in order that no seeds may be allowed to ripen. The roots must be thoroughly desiccated; for, if suffered to lie in a moist place, they will continue to vegetate on the surface, and strike their rootlets into the ground. Docks should be *pulled up by hand after heavy rains*, when the soil is soft enough to allow their long tap roots to be drawn without breaking, and before their seeds approach to ripeness; but this is a matter of extreme difficulty, unless the ground is very loose. The best plan, perhaps, is to dig them out with a spade.

In the sowing of clover on arable land care should be taken that none of the seeds (really the fruits) of the dock are intermixed. They cannot be separated by the sieve, for they are too nearly of the same size as the red clover; but they may be distinguished by their bright brown colour and triangular form, and their general resemblance to very small buckwheat seed. Should the dock unfortunately be sown, it must be carefully drawn or spudded up as soon as it appears above ground. Seedling docks are largely destroyed by hoeing, and this is the quickest way of dealing with them; were the hoe used in the root crops later in the year—in the autumn—seedling docks and seedling couch, which become established after that time, would have little chance of causing trouble.

The WATER DOCK (*Rumex aquaticus*, L.) is a troublesome weed in grass land. It is most common on land adjacent to streams which flood

naturally, or by irrigation, as in water meadows. It is almost impossible to keep the water dock out of these fields, because the herbage on the sides of the streams is not always cut, and the docks form seed, which is carried away by the water and dispersed about the meads. It is only by constant warfare carried on by all who manage the land along the stream that this pest can be kept in check. Its eradication in grass land is similar to that of the common dock under the same circumstances. The seed may be readily established in ordinary meadows, and to a less extent in arable fields. Therefore great care must be taken to avoid distributing the seed.

The **SORREL**, or **SOUR DOCK**, is an exceedingly common weed of grass-lands, particularly hay fields. There are two species—the common sorrel (*Rumex Acetosa*, L.), and the sheep's sorrel (*Rumex Acetosella*, L.)—both of which are characterized by their rich green pointed leaves with acid flavour. The dark crimson inflorescence of these sorrels is only too conspicuous a feature of many meadows in the month of June. These plants are perennial, like the docks to which they are so nearly allied, and the measures recommended for the suppression of the latter should prove equally useful in the case of the sorrels.

Of *Thistles* there are several kinds : among the most noxious are the



Fig. 370.—Thistle Extirpator or "Docking Iron."

bur-thistle, the corn-thistle or corn saw-wort, and the sow-thistle. The bur-thistle, being a biennial plant, may be killed at any time by cutting it under the first leaves. But the corn- and sow-thistles, which are perennials, and extend their creeping-roots beyond the reach of the plough, are more difficult to eradicate.

The **BUR-THISTLE** may be removed by the use of the thistle extirpator (fig. 370), which levers out the whole root. A is the handle ; B the claws between which the thistle is received ; the curved iron C is the fulcrum, by means of which a purchase is obtained for extracting the



root. D is an iron rod or bar, upon which the foot is placed to thrust the claws into the ground. In case the root of the thistle breaks, during the endeavour to extract it, the curved blade E, which has a sharp end like a chisel, is thrust into the ground, in order to cut off the root some inches below the surface, but the advantage of this is doubtful, and the chisel end is usually omitted.

If thistles are cut down in rainy weather, or if much rain falls soon afterwards, the water descending into the fresh wound of the stem (where cut by a spud) weakens the roots, and prevents the growth of the plants for a time. But if such opportune rains do not occur, fresh leaves will immediately arise from the dormant buds in the region of the neck or "collar," and the cutting will produce very little effect. They should, therefore, be annually pulled up as soon as possible after the flower begins to form, taking advantage of the first shower that happens to fall to soften the ground and make them draw freely. By pursuing this practice regularly during several years, the deep-lying perennial roots will become gradually weakened, and fall into decay.

The CORN-THISTLE (*Serratula tinctoria*, nat. ord. *Compositæ*), often known as the COMMON WAY-THISTLE, is a weed which grows chiefly in rich clayey soils; but is common to all. Its "seeds," being light and feathery, float on the wind, and sow themselves everywhere. Even after a fallow many of these weeds will rise in the following spring. It is not sufficiently understood that thistle roots do not die if cut and left in a moist tilth; they must be drawn out by curve-tined harrows and killed by exposure. The presence of thistles in young pastures is frequently due to the fact that the roots were not dragged out before the seed was sown. It is a difficult but necessary task to keep them under, for there is no weed so unsightly or so injurious as this.

The SOW-THISTLE (*Sonchus arvensis*, L., or *oleraceus*, nat. ord. *Compositæ*), which is remarkable for the regularity with which it opens its flowers at six o'clock in the morning and closes them at noon, sadly troubles the farmer, and impoverishes the soil where it is permitted to gain any head. The presence of this weed in large quantities generally denotes poverty in the soil, and liberal manuring will check it because the grasses will grow more vigorously. The sow-thistle most commonly grows on banks and in hedge sides, but the previous remark applies to all of the softer-prickled thistles, and also to dandelions and plants allied to them. They may be cut out with a spud with much temporary though not permanent advantage. It is extremely difficult to destroy them on grass land, but they may be kept in check by constant spudding below the surface while young; or, by cutting above the surface just before the thistle comes into flower, the water will run down the stem and rot the plant far into the root, thus causing a weaker growth in the future.

The SPEAR PLUME-THISTLE (*Cnicus* or *Carduus lanceolatus*, L., nat.

ord. Compositæ), is a weed which often grows in abundance in old pastures: its presence is to be attributed to neglect, for it could be easily destroyed by cutting it when in flower, and before its seeds are ripe.

Thistles of all kinds are widely disseminated by means of their light downy "seeds." They should, therefore, be cut down before the seeds (strictly speaking, the fruits) are ripe; and it should be a golden rule with the farmer never to suffer a thistle to grow in any of the waste places or hedges of his farm. In some countries there are penalties inflicted on those who allow thistles to remain in their hedges, or along the high-road which borders their land.

RAGWEED (*Senecio Jacobæa*, L., nat. ord. Compositæ), or RAGWORT, as it is also called, not being deeply rooted, is best extirpated by the hand. Cutting it down will be of little service, for, though some of the plants die, many survive, and branch out more copiously in the following year. It is a mere weed, of no beauty, and is much larger than the closely allied common groundsel, *Senecio vulgaris*. When the ground is softened by rain at about the period of its flowering, it should be pulled up by hand; or it may be kept down by pasturing with sheep, as these animals will eat it when it is young, but *hoeing* while weeds are young is by far the best and cheapest means of keeping weeds in check.

GROUNDSEL (*Senecio vulgaris*, L., nat. ord. Compositæ) is one of the most common of the annual weeds, and flowers from March to December. It can scarcely be extirpated where it has once grown, though it may be kept in check by hoeing. It is a weed of arable land. It is not remarkable either for beauty or for utility, but it is gathered as food for cage-birds, particularly the canary-bird, and contributes largely to the support of most small birds. It has been calculated that, on an average, the number of flower-heads borne by each plant of the groundsel is 130; number of seeds in each flower-head, 50; and thus each plant bears 6,500 seeds.

COLTSFOOT (*Tussilago Farfara*, L., nat. ord. Compositæ) is so-called from the similarity of the flower-buds to the foot of a colt. The flower-head appears before the leaves, and the seeds ripen early and are dispersed by the wind before the corn crop ripens. The presence of coltsfoot is one of the surest signs of wetness in the soil, and the plant cannot be eradicated until the land is thoroughly drained. It is a weed which chiefly infests arable land, though it occasionally appears on very wet and poor pastures.

The BURDOCK (*Aretium lappa*, L., nat. ord. Compositæ) is a frequent weed on the hedge-side. It is known by its very large leaves, whilst the flower-head is furnished with hooks, which stick obstinately to the clothes of those who rub against it, and particularly to the hair and wool of animals. Beyond this it does no harm, and, growing singly to a large size, may be easily extirpated by spudding.

The **DAISY** (*Bellis perennis*, L., nat. ord. Compositæ).—We are sorry to have to record this pretty flower (the day's eye) among the weeds which the farmer should endeavour to extirpate. An old writer terms it, we scarcely know why, "the dissembling daisy." Cattle certainly will not eat it, but we know not any further harm about it than that, by means of its rosette of horizontal close-lying leaves, it occupies ground which might bear nutritive plants. Where it grows in great abundance it tells tales of the poverty of the soil, and liberal manuring is the only means of keeping it in check when once it is established.

**GOOSE-GRASS** (*Galium Aparine*, L., nat. ord. Rubiaceæ), also called catchweed, cleavers, hariff, whiptongue, and goose-tongue. The "seeds"—or rather the fruits—of this plant are furnished with hooked bristles, which attach themselves to everything that rubs against them, and thus are widely disseminated. Where it is once suffered to establish itself it will not be eradicated without some difficulty. It is exceedingly common in hedgerows, and its presence in arable fields indicates richness of the soil: it is very common in the Fens. Poultry are extremely fond of it, and for young turkeys it is almost a necessity. Rabbits eat the herbage.

**COUCH**, or common **WHEAT-GRASS**, **TWITCH**, or **QUITCH** (*Triticum repens*, L., nat. ord. Gramineæ).—This weed appears and flourishes in every soil, and under every possible system of management. If once a field has become infested with it, and especially one that is at all liable to suffer from dampness, the very best fallow will leave some of it in the land, for its creeping netlike underground stems will shoot again as long as any portion of them remains. The most effectual means of destroying it are frequent ploughing and harrowing, naked summer fallows, forking, and collecting the roots with the hand. On prime old pastures couch-grass appears fortunately to be unable to maintain its position.

**KNOT-GRASS** (*Polygonum aviculare*, L., nat. ord. Polygonaceæ), known among farmers by the names of *surface twitch*, *red robin*, and *hogweed*, is not a little mischievous amongst both corn and root crops. It must be kept in temporary subjection by the hoe, but unless a system of cropping is adopted which does not allow the plant to seed it is impossible to eradicate it. It is considered one of the greatest curses on light soils, especially on the sharp gravels, and sands. It is found in almost incredible quantity on some of these soils, although they have been skilfully worked, and carefully hoed for generations, and its presence does not necessarily indicate poverty, for it is found in great abundance on soils highly manured by sheep.

**SNAKEWEED** (*Polygonum Bistorta* and *P. lapathifolium*, L., nat. ord. Polygonaceæ), or pale-flowered persicaria, infests meadows and corn-fields; when dry it resembles the folds of a snake, and is of a brownish-red hue and fleshy appearance. It has no smell, but a pecu-

liarly astringent taste. On account of the shape of its leaves it is, in some localities, called willow-weed.

**CLIMBING BISTORT, or BEARBIND** (*Polygonum Convolvulus*, L., nat. ord. Polygonaceæ).—This is a very injurious weed, and difficult to get rid of, on account of the roots penetrating so deeply into the soil as to render it almost impossible to eradicate them. It is one of the prettiest of the native plants of this genus; but it twines round wheat, turnips, and other plants, and prevents them from attaining their proper growth. It cannot be too persistently suppressed.

**CORN MINT** (*Mentha arvensis*, L., nat. ord. Labiatæ).—This weed chiefly prevails in moist pastures, and its creeping roots are difficult to extirpate. It will always be best conquered by correcting those defects of the soil which encourage its growth,—by draining and paring.

The **RED DEAD NETTLE** (*Lamium purpureum*, L., nat. ord. Labiatæ).—This plant has established itself in all our hedges, whence it is apt insidiously to encroach on land destined to better purposes. It has an aromatic earthy odour.

**CHARLOCK, or WILD MUSTARD** (*Sinapis arvensis*, L., nat. ord. Cruciferae).—This weed thrives in most soils, and is a seriously troublesome pest. It is utterly useless, except that the seed is saleable for adulterating cakes and feeding stuffs, a practice which must be condemned. It is not a pasture weed. When land is much infested with it, it is necessary to subject it to a long fallowing: the best method is to leave the land after a corn crop unploughed during autumn, but it may be harrowed to promote germination. Where the seeds lie on the surface they are readily eaten by birds. It is advisable to plough the land very shallow in the spring so that the seed may be kept near the surface; the land should occasionally be harrowed during spring so that as the seeds germinate they may be killed, and a fresh supply of seeds be brought to the surface to germinate, as they cannot grow if buried deeply. This process should continue until such time as the land is required for sowing with roots, when a deeper furrow may be ploughed. This will probably contain many seeds, which will prove troublesome, but this may be avoided by putting in a crop, such as cabbages, by transplanting; horse-hoeing and hoeing can then continue uninterruptedly, and the crop will grow unchecked whilst the land is being freed from the pest. Considerable success attended the trials that were made in many parts of the country during 1899 of the efficacy of sulphate of copper as a destroyer of charlock growing amongst corn crops. A 2 per cent. solution of sulphate of copper sprayed at the rate of 40 gallons per acre, before the young charlock plant had got into its sixth leaf, was found very effective. Care should be taken that the sulphate of copper is pure, and especially that it is not adulterated with sulphate of iron. The spraying can be done with Strawson's Charlock Destroyer (see p. 730).

**SMALL NETTLE** (*Urtica urens*, L., nat. ord. *Urticaceæ*).—This plant too often spreads itself from the hedgerows, and from under the walls, which nature seems to have selected for its domicile, to the better and cultivated parts of the farm. It should be carefully eradicated before the seed time. Its presence usually indicates that the soil is rich in humus.

**The STINGING NETTLE** (*Urtica dioica*, L., nat. ord. *Urticaceæ*).—This plant also is found in all waste places, under walls, and on the banks of hedges. It is exceedingly objectionable, for it is not only difficult to extirpate, but when it has once taken possession of a piece of ground, every other plant dies away. It must be dug up by the roots before it flowers, but loosening the soil favours its growth, and the only sure method of keeping it down is to consolidate the land as much as possible. It springs up with great vigour on land which has previously been occupied by barns or other old buildings.

**CROWFOOT** (*Ranunculus* sp., nat. ord. *Ranunculaceæ*).—There are various species of this weed, known under the name of “butter-cup,” “king cup,” “golden cup,” &c. They all possess an acrid or poisonous principle, and are said to be injurious to cattle and to their milk. It is only, however, when they exist in large quantities that this is the case; where but few of them mingle with the grass, they serve as a condiment, and possibly cause the coarse herbage of pastures to be more easily digested. It is a popular error to suppose that they impart a yellow colour to the butter. Experiments have been made on the poisonous quality of the *Ranunculus*. A small quantity of the expressed juice has killed a dog, and many a time the most painful and troublesome swellings have been produced by the absurd practice of applying poultices or plaisters of the root of the butter-cup to sores. In some cases the ulceration thus set up has resulted in caries of the bones.

**WILD RADISH, or RUNCH** (*Raphanus Raphanistrum*, L., nat. ord. *Crucifereæ*), closely resembles the wild mustard, but its flowers are white not yellow, and both these plants are commonly termed charlock.

**CORN POPPY** (*Papaver Rhæas*, L., nat. ord. *Papaveraceæ*), is well known from its brilliant red flowers; it abounds mostly in dry, sandy, or gravelly soils. One plant produces, on an average, 50,000 seeds.

**CORN BLUE-BOTTLE** (*Centaurea Cyanus*, L., nat. ord. *Compositæ*).—This is also chiefly found in corn-fields, but it never thrives to any great extent, or where proper attention is paid to the cleaning of the soil.

**BLACK Knapweed** (*Centaurea nigra*, L., nat. ord. *Compositæ*).—This weed cannot be extirpated without difficulty; it is propagated by its roots as well as its seeds. Before blooming, the flower-head has the appearance of a hard blackish scaly knob, whence the plant is some-

times termed "hard-head." It is a sure sign of poverty in the soil and possesses no feeding value, although the seed is, perhaps, the most highly esteemed food of goldfinches. It is wiser to cut the plant before it seeds, but manuring is the only permanent remedy.

**CORN MARIGOLD** (*Chrysanthemum segetum*, L., nat. ord. Compositæ), or yellow ox-eye.—This plant grows amongst corn; in some parts it is only found here and there, but in sandy districts it is a most pernicious weed, growing so vigorously and multiplying so rapidly as to ruin the crops; it germinates late in the year, and rapidly ripens its seed, which falls out, as a rule, in harvest, literally covering the ground. Few weeds are so difficult to extirpate, or more injurious to the crops among which they grow. The yellow flower-heads and the seeds are poisonous, therefore when chaff which comes from the threshing-machine contains many of them it is unsafe for feeding purposes. It is possessed of great vitality, and, when pulled up and thrown aside, does not perish and decompose, but continues growing and ripens its seed. Thaër says that the seeds of this plant will pass through the bodies of horses and other animals without losing their vitality, and thus the chrysanthemum is sometimes propagated by means of the dung. Frequent summer tillage will alone destroy this weed, when once it has overrun the land.

The **BEARDED WILD OAT** (*Avena fatua*, L., nat. ord. Gramineæ).—This is another very pernicious weed, most commonly affecting heavy land. As it ripens before corn crops, and sheds its seed on the land, it is looked upon by heavy-land farmers as one of their most obnoxious weeds. When once it has got a hold upon land it cannot be got rid of without prolonged fallowings. See page 914.

**RYE BROME GRASS** and **SOFT BROME GRASS** (*Bromus secalinus*, L., and *Bromus mollis*, L., nat. ord. Gramineæ).—These are found among the weeds of cultivated land. They thrive chiefly in damp soils, and will then often choke the crops, but on dry, gravelly, or sandy soils they are scarcely ever met with. See page 922.

The **CHICKWEED** (*Stellaria media*, With., nat. ord. Caryophyllaceæ), flowering from March to December, is, under careless management, often a nuisance to the agriculturist. This and the groundsel are very troublesome weeds, and will sometimes almost choke young crops, but are comparatively harmless when crops have attained fair growth. It has small white flowers, open almost all the year. It is sometimes eaten as a potherb, and small birds are very fond of its seeds. It is allied to the stitchwort of the hedgerows.

**CORN-COCKLE** (*Lychnis Githago*, Lam.), and **CORN-SPURREY** (*Spergula arvensis*, L.), are both members of the nat. ord. Caryophyllaceæ, or Pink Family, and come up singly. They indicate a poor soil, or

neglect in the cultivation. Samples of wheat are often infested with black "cockle" seeds.

**BRAMBLES**, which are shrubs of the rose, blackberry, and dewberry family (nat. ord. Rosacæ), must also come under the head of weeds, where they encumber land which is, or ought to be, devoted to agricultural purposes. They are not easily suppressed, and their long prickly shoots twine round and destroy all vegetation within their reach. Their roots penetrate very deeply, and ramify in every direction. They must be worked out of the surface soil before land can be profitably cropped.

**HEATHS** (Ericæ).—These plants, the benefit of which will generally be more quickly realised if the land is limed, though useful and ornamental on the sandy waste, ought never to be found upon cultivated grounds, and, when present, must be regarded as weeds.

**RUSHES** (Junci).—When these intrude into situations that should be occupied by better plants, they must be destroyed. They are common in moist meadows with a retentive subsoil. They not only occupy space that might produce good herbage, but greatly deteriorate the hay with which they are mixed. The farmer should leave no means untried to get rid of them, and persistent cutting will be found useful to this end. Where they have once been permitted to grow, they can only be effectually destroyed by draining. Their presence is a characteristic of wet land.

**FERNS** (Filices) grow chiefly in hedges, or on mountainous and upland pastures.

**MOSSES** (Musci) are not wholly innutritious in themselves, but they have a tendency to overrun the ground, and, by their closely-woven fibres, to prevent the growth of vegetation. It is more probable, however, that the herbage plants die away first, and the mosses invade the area which is thus left bare; a sign of poverty, which can be set right by the application of manure. Lime is often found especially valuable in such cases.

The weeds that have been specifically named are arranged in botanical sequence below, with a reference to the page upon which each is described:—

<i>Ranunculacæ</i> .—Crowfoot or Buttercup, p. 857.	<i>Compositæ</i> .—Spear Plume-thistle, p. 853. Ragweed, p. 854. Groundsel, p. 854. Coltsfoot, p. 854. Burdock, p. 854. Daisy, p. 855. Corn Marigold, p. 858. Corn Blue-bottle, p. 857. Black Knapweed, p. 857. <i>Labiataæ</i> .—Corn Mint, p. 856. Red Dead Nettle, p. 856.
<i>Papaveracæ</i> .—Corn Poppy, p. 857.	
<i>Cruciferæ</i> .—Charlock, p. 856.	
Wild Radish, p. 857.	
<i>Caryophyllacæ</i> .—Chickweed, p. 853.	
Corn Cockle, p. 858.	
<i>Rubiacæ</i> .—Goose-grass, p. 855.	
<i>Compositæ</i> .—Bur-thistle, p. 852.	
Corn-thistle, p. 853.	
Sow-thistle, p. 853.	

*Polygonaceæ*.—Common Dock, p. 851.  
 Water Dock, p. 852.  
 Sorrel, p. 852.  
 Knot-grass, p. 855.  
 Snakeweed, p. 855.  
 Bearbind, p. 856.

*Urticaceæ*.—Small nettle, p. 857.  
 Stinging nettle, p. 857.  
*Gramineæ*.—Couch-grass, p. 855.  
 Wild Oat, p. 858.  
 Rye Brome-grass, p. 858.  
 Soft Brome-grass, p. 858.

In the foregoing paragraphs, we have here and there given statements showing how prolific are our common weeds in the production of seed, with what ease these seeds are transported from place to place, and how rapidly they take root and flourish. The great importance will be seen, then, of preventing the seeding of weeds, and of remembering the truth of the old adage:—"One year's seeding is seven years' weeding."

**POISONOUS PLANTS.**—The following native British plants are all more or less poisonous:—

Common Name.	Systematic Name.	Natural Order.
Monkshood . . . . .	<i>Aconitum Napellus</i> , L.	Ranunculaceæ.
Red-berried bryony . . . . .	<i>Bryonia dioica</i> , L.	Cucurbitaceæ.
Hemlock . . . . .	<i>Conium maculatum</i> , L.	Umbellifereæ.
Fool's parsley . . . . .	<i>Æthusa Cynapium</i> , L.	"
Water dropwort . . . . .	<i>Cenanthe</i> sp.	"
Water parsnip . . . . .	<i>Sium</i> sp.	"
Cowbane . . . . .	<i>Cicuta virosa</i> , L.	"
Henbane . . . . .	<i>Hyoseyamus niger</i> , L.	Solanaceæ.
Woody nightshade or bitter-sweet.	<i>Solanum Dulcamara</i> , L.	"
Deadly nightshade . . . . .	<i>Atropa Belladonna</i>	"
Figwort . . . . .	<i>Scrophularia</i> sp.	Scrophularineæ.
Foxglove . . . . .	<i>Digitalis purpurea</i> , L.	"
Meadow saffron . . . . .	<i>Colchicum autumnale</i> , L.	Melanthaceæ.
Darnel . . . . .	<i>Lolium temulentum</i> , L.	Gramineæ.
Yew . . . . .	<i>Taxus baccata</i> , L.	Coniferæ.

In addition to the poisonous plants just enumerated there are several others which, if not poisonous, yet possess the capacity of adversely affecting the flavour or quality of milk. They include the hedge mustard (*Sisymbrium Alliaria*, Scop., nat. ord. Crucifereæ); also known by such names as garlic mustard, sauce alone, and Jack-by-the-hedge; it has a powerful onion-like odour. Of strong-smelling compositaceous plants, objection should be taken to the tansy (*Tanacetum vulgare*, L.), which grows in waste places; the wormwoods, especially *Artemisia Absinthium*, L., which is common in hedgerows; the wild chamomile, or feverfew, *Matricaria Chamomilla*, L.; the common chamomile, *Anthemis nobilis*, L.; the corn chamomile, *Anthemis arvensis*, L.; and the stinking chamomile, *Anthemis Cotula*, L. The butterwort, *Pinguicula vulgaris*, L. (nat. ord. Lentibulariaceæ), and the various species of garlic, chives or ransoms, belonging to the genus *Allium* (nat. ord. Liliaceæ), are also to be avoided.



## CHAPTER X.

## ON PARING AND BURNING.

THE *paring* of land is a practice of long standing in this island,<sup>1</sup> particularly in the west of England, where it is also denominated (in conjunction with *burning*) *den-shiring*, *burn-baiting*, or *sod-burning*. It consists of cutting or paring off the turf, or surface of the ground, and piling it, to dry, in heaps, which are afterwards kindled and burnt to ashes that are spread over the surface and ploughed in. The best season for this operation is from the latter end of February, throughout March if the north-east wind prevails, and to the end of May. The ashes should be spread out as regularly and equally as possible before the plough, and turned in immediately. By breaking up old grass or sainfoin leys, in this manner, they are prepared for turnips with only one ploughing; and thus not only much expense and tillage are saved, but the destructive turnip-fly seldom attacks turnip crops on burnt lands.

The operation is performed on different soils with different implements. Thus, in *old pastures* or *meadows*, the breast-plough is an effective implement, but either Bentall's broad-share or the paring plough is perhaps the best to use, as doing most work at least expense. From one inch to one inch and a half is the usual depth, although two inches are preferable in the opinion of some agriculturists, on account of the greater quantity of ashes thus produced; but this is a point which must be regulated by the nature and depth of the soil. The burning, however, will be more certain, in case of unfavourable weather, in proportion to the thinness of the turf. The expense of paring such land (including its burning and the spreading of the ashes) varies from 1*l.* 5*s.* to 2*l.* per acre.

In *fenny* or *boggy* situations, as in Cambridgeshire, a useful implement called the *paring* or *skim-plough* may be employed. It turns off

<sup>1</sup> We have more ancient records than the history of our own country affords. Virgil describes it as an acknowledged and useful practice among the agriculturists of ancient Rome. Some of the reasons which he gives are singular and valuable.

“ Oft, too, it has been gainful found to burn  
The barren fields with stubble's crackling flames.  
Whether from thence they secret strength receive  
And richer nutriment; or by the fire  
All latent mischief and redundant juice  
Oozing sweats off; or whether the same heat  
Opens the hidden pores, that new supplies  
Of moisture may refresh the recent blades;  
Or hardens more, and with astringent force  
Closes the gaping veins, lest drizzling showers  
Should soak too deep, or the sun's parching rays,  
Or Boreas, piercing cold, should dry the glebe.”

Trapp's *Georgics*, i. 125.

a furrow from twelve to sixteen, and even eighteen, inches in breadth, and not exceeding one inch in depth. By using this instrument, the cost of paring, burning, and spreading is considerably reduced; but it is calculated for such soils only as have been in a state of cultivation. In many of our western counties this operation is performed with the common plough, a wing being turned up on the furrow side of the share, in order that the furrow may be cut of the required depth. The manner of piling the sods varies with the locality; but, in general, the operation of burning will be most effectually performed by piling the parings into small cocks or heaps, similar to those made in hay-fields, placing the grass sods downwards for the admission of air, and leaving apertures both at the top and at the bottom of each heap. These apertures must afterwards be closed up with fresh sods, in order that the burning may be thorough.

There is great difference of opinion among agriculturists as to the propriety or impropriety of paring and burning land. By some it is pronounced to be a wasteful, extravagant operation, resulting in the dissipation of that which should be retained. This opinion is strongly controverted by others equally experienced in the various departments of rural economy. Perhaps the best judgment to be pronounced is that the operation is beneficial in some cases, and harmful in others. Many years ago, when wheat was very high in price, a great deal of good pasture was pared and burned in Ireland. The results were declared to be good crops for a year or two, and signs of exhausted fertility later, and there is no doubt that it is a wasteful plan to pare and burn good pasture. On the other hand, in reclaiming waste land, sour and full of weeds and roots, the operation is probably the best and most economical method of bringing the land into good condition for cultivation and cropping. In the former case, the organic matter which is destroyed by fire is valuable, whereas, in the latter case it is chiefly worse than valueless.

The operation of paring and burning may be advantageously performed on *heaths* and *downs* occupied by a thin, weak, and loamy sand, with a calcareous bottom. The burning can only be effected in dry weather. Considerable tracts of such land have been broken up and reclaimed in many parts of the kingdom. Land thus treated is generally of the very worst kind. The chief object of paring is to get rid of coarse herbage and perennial weeds, which, by the process of burning, leave their mineral ingredients to act as a stimulating manure. The effect of the operation is to purify the soil from that which is chemically and organically objectionable. Coarse herbage, the stems and seeds of weeds, as well as insects with their eggs and larvæ, are destroyed.

*Moory, fenny, and boggy* or *peaty* soils derive very essential benefit from this practice.

Some *chalk lands* have been greatly improved by paring and burning, and so likewise have *loams*.

*Clayey soils* may occasionally be pared and burned with much benefit,

especially when broken up for the first time, for the incorporation of the ashes opens the soil so much that the roots of plants can afterwards feed therein, and fine crops of wheat may be raised. Clay ashes, or rather the nodules of burnt clay, tend to diminish the stubborn adhesion of stiff tenacious clays, and form an excellent addition to the soil. The breast-plough is the best implement for such soils.

Upon the whole, then, the paring and burning of land may be beneficially resorted to on many soils especially those which have been barren for any length of time. On bad grass lands the operation is useful, provided it is conducted with caution, and the ashes are spread as speedily and uniformly as possible over the surface, and that especial care is afterwards taken not to exhaust the soil by repeated crops of corn when it is intended to be again laid down to grass.

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## CHAPTER XI.

### ON DRAINING.

**T**HERE is no operation more essential to the improvement of many classes of land than draining.

Though vegetation cannot progress without an ample supply of water, yet in many soils water is so superabundant as to be productive of the most injurious consequences, causing the herbage to be coarse, watery, and inadequate to the proper support of cattle fed on such pastures.

Draining often constitutes a *sine quâ non* in good farming, in the absence of which all other operations, however tedious, or laborious, or expensive, would be utterly ineffectual. Whilst the soil is saturated with water, it cannot be subjected to any successful system of tillage, or adequately pulverised. It is impossible, moreover, for manures to be productive of anything like their full and proper effect, unless the soil has first been brought into an appropriate state for their reception.

Excess of moisture in the soil is usually attributable to one of two causes, viz., to rain water or other moisture resting on a surface which is either impervious itself or rests upon an impermeable stratum, or to the water of springs pouring over it, or confined beneath it. In strong clays the first-mentioned is usually the predominating cause, but in most other soils the evil chiefly arises from the second. It is, therefore, necessary that the farmer should inquire into and fully ascertain the cause, before he takes any steps towards removing the evil.

In past years drainage has been the means of effecting the reclamation of many hundred thousands of acres of waste land, as well as of

increasing greatly the productive powers of land which had been long under cultivation.

As no one system of drainage can be regarded as universally applicable to all soils, the method to be adopted in any particular case must be largely determined by local considerations.

If the land is not marked by any great inequality of surface, and the wetness proceeds from the texture of the soil, particularly of the substratum, the system of thorough under-draining applied to the whole field is, perhaps, the best cure of which the evil will admit. On the contrary, where the land is situated on a declivity, and springs break out on the slope, causing great damage to the land below, the first object must be to intercept these at their head, and divert them before they saturate the soil with their moisture. Their site may be ascertained by means of an auger or borer, and the subsequent measures taken accordingly.

Where there is much irregularity of surface, it will often be found that the clayey and impervious strata do not extend far up the rising ground, and that more porous strata cover and encircle the top. The moisture received by these upper strata percolates through the open and porous soil until it meets with obstruction from the more impervious one; there it accumulates and forces a passage, either oozing almost imperceptibly, or bursting out in streams. In either case it seriously injures the land, both at this spot and immediately below. The object of draining must be to intercept these streams, and lead them by an artificial channel to some outlet where their waters, if not turned to some useful purpose, may at least cease to operate injuriously.

The method which was formerly resorted to in the counties of Essex and Herts, and is still used for tolerably level lands, and which has been generally found to answer, was termed *hollow-draining*, *bush-draining*, or *land-ditching*. It consisted in digging main drains and ploughing side drains; the depth of the main drain varying from 22 to 24 inches, and that of the side drains from 20 to 22. The length to which the main drain was continued without a vent depended on the situation of the land. If there was a gentle slope, as much water as possible was carried off by means of side drains; where, however, the surface of the ground was uneven, it became necessary to form additional main drains. The length of the side drains and their distance apart depended upon the nature of the land. The trenches of a sufficient depth, being cut off, were filled up with stones, or with brushwood, or thorns; perhaps branches of the alder or willow are preferable, as being less liable to decay, and also, being smooth, they do not disturb the shape of the drain so much. They should, however, be used in a green and never in a dry state. The stones or twigs were then covered over with straw, fern, heather, &c., in order to fill up the interstices and prevent the earth from sinking in, and the surface soil was laid on archwise. In making drains of this kind, the chief object was, not the durability of the materials, but the proper *arching* of the earth, which, when of a tenacious nature, remains perfect after the

other materials are decayed. The soil immediately over the trench was left a little higher, as its tendency is invariably to sink. In several parts of Essex there are drains of this kind, which answer very well, although they were only filled with twisted straw, and were made more than sixty years ago. The expense is stated to be about 3*l.* per acre. Mr. Pusey was of opinion, that on heavy clay-lands this mode of draining answered better, and was very much cheaper, than any other; but this was before draining-tiles could be manufactured at the price, and with the rapidity and facility, which machinery has now rendered possible.

The antiquity of this mode of draining, especially in our midland counties, is demonstrated by various accounts which were collected

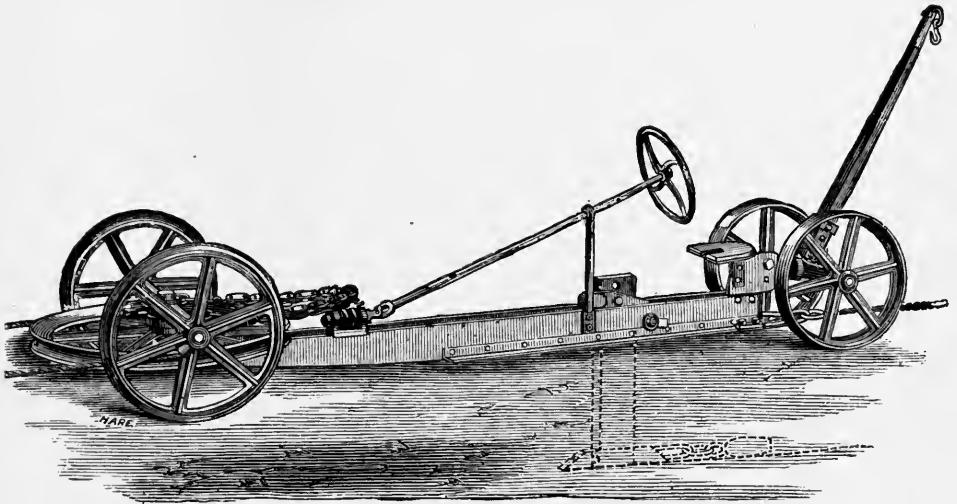


Fig. 371.—Fowler's Mole-Plough.

together by Mr. Pusey, and published in the "Journal of the Royal Agricultural Society."

Mole-plough drains, for rapidly taking off excess of surface water, have also been extensively adopted. Some of these in the North, which were examined after thirty years' use, were found to be acting perfectly. Fowler's draining-plough may be used either as a mole-plough or to put in pipes. In the latter case it aims at making a complete pipe-drain at a single operation, the drain-pipes being strung on a rope, and rope and pipes together drawn through the soil, behind the mole fixed on the points of the coulter. It may be worked to a depth of  $3\frac{1}{2}$  feet in suitable soils, and either by steam or horse-power. Draining by means of the mole-plough, however, even where no pipes are put in, can only be practised to a very limited extent in Britain. Fig. 371 shows the improved form of Fowler's mole-plough. The strong coulter carries on the back of its point a mole or plug, which, as it is drawn through the soil, leaves an open channel behind it. The

channels thus made in the land deliver into properly constructed main drains with pipes of sufficient size. The implement can only be used satisfactorily on homogeneous clays, or free loams, and is better suited to grass lands than to arable soils.

Sod- or turf-drains, which have been adopted on tenacious grass lands, are thus formed: A wedge-shaped sod or piece of turf is cut from the furrow or line of the intended drain, the point of the wedge is cut off, and the turf or sod then again inserted into the soil. But land in which drains of this sort are used is never sound, or fit for cattle.

In all cases, the apertures or mouths of drains should be effectually guarded by a railing, or grating, to prevent the watercourse from being obstructed; and the passage for the water should uniformly be narrow at the bottom, as the pressure of the flowing liquid will be fully adequate to remove any accidental impediments to its course, and consequently such drains will be more durable.

Where materials are dear, *stone drains* may be resorted to with advantage. They should be cut 10 or 12 inches wide, with perpendicular sides, and lined with flat stones so disposed as to leave a watercourse at the bottom, by setting two of them in such a manner as to meet triangularly at the edges. The cavity of the drain should be filled nearly to the top with loose stones, for which coarse-screened gravel may be advantageously substituted, where a sufficient quantity can be obtained. In loose sandy or peaty soils, where earth drains would last but a short time, pipes or tiles should be employed. The expense of these was formerly an obstacle to their being employed to any extent, but now, by the aid of improved machinery, they are within the reach of all agriculturists.

The varieties of soils met with in the practice of draining may be classified thus: 1st, *Light soils*: light gravelly loam, light marly loam, sandy loam, soft light loam, sandy soil, light gravelly sand, deep gravelly sand, coarse gravelly sand, loose gravelly sand. 2nd, *Medium soils*: clayey loam, marly loam, gravelly loam, friable loam. 3rd, *Heavy soils*: compact tenacious gravelly clay, soft adhesive clay, free soft clay. The practice of draining may be divided into three classes of operations, respectively concerned with: *first*, the laying out and direction of the drains; *secondly*, the depth of the drains; *thirdly*, the distances between the drains. To these may be added the considerations of *fourthly*, the materials used in the construction of the drains; and *fifthly*, the cost of the drains. The laying out and the direction of the drains has been a subject of considerable controversy, two opinions having been brought forward; namely, on the one hand, that the direction of the drains should be in the line of greatest fall, in the slope of the ground; and, on the other hand, that the drains should be transversely to, or across, the fall or slope of the ground. The weight of evidence is decidedly in favour of the first mode, namely, running the drains in the direction of the slope.

Of the first mode, according to Mr. Smith of Deanston: "Drains drawn across a steep, cut the strata or layers of subsoil transversely,

and as the *stratification generally* lies in sheets at an angle to the surface, the water passing in or between the strata, immediately below the bottom of the drain, nearly comes to the surface before reaching the next lower drain; but as water seeks the lowest level in all directions, if the strata be cut longitudinally by a drain directed down the steeps, the bottom of which cuts each stratum to the same distance from the surface, the water will flow into the drain at the intersecting point of each sheet or layer, on a level with the bottom of the drain, leaving an uniform depth of dry soil." In favour of the second mode of running the drain across the slope, Mr. G. Stephens, author of a treatise on drainage and agriculture, has the following: "A drain made across the slope or declivity of a field, or any piece of land, will undoubtedly intercept more water than when it is carried straight up the bank or rising ground; this principle holds good in every case, whether the drain be made to receive surface or subterraneous water. Drains winding across the slope or declivity of a field, whatever their number or depth may be, their effect upon tenacious or impervious substrata will be much greater than if they were made straight up and

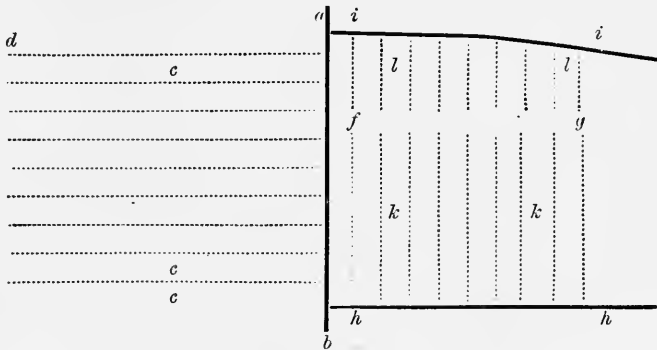


Fig. 372.—Plan of Drainage.

down the slope; and when the soil is mixed with thin strata of fine sand, which is the case nine times out of ten, the effect will be increased in proportion, and accordingly a much less number will answer the purpose."

Drains are ranged under three classes, "main-drains, sub-drains, and small, or furrow-drains." The main-drains are those into which all the other drains deliver the water, and which lead the united flow to the point of outfall. The position of these mains should be invariably along the lowest part of the field, or principal hollow. Where the length of the small or furrow drains is such as to give them a great quantity of water to deliver, it will be advisable to divide the length, and allow the first half to deliver into a "sub-main"—this communicating directly with the "main." Where there are minor or secondary hollows in the field to be drained, "sub-mains" should be placed in these hollows.

Thus let  $ab$  (fig. 372) be the main drain; all the drains  $cc$ , running down the slope tending from  $de$  to  $ab$ , drain directly into the main drain  $ab$ . But, on the other side of the main drain  $ab$ , the field does not slope towards the main, but slopes in two different directions. Thus the vacant line  $fg$  represents the ridge or highest part, the slope on one side of this being from  $fg$  to  $hh$ , and on the other from  $fg$  to  $ii$ . The one side or slope of the hill  $kk$  is therefore drained by drains  $kk$ , leading into the "sub-main"  $hh$ , which again communicates with the main drain  $ab$ —the other side or slope  $ll$  being drained by the drains  $ll$ , leading into the "sub-main"  $ii$ , and that finally into the "main"  $ab$ .

A common kind of plan is shown in fig. 373. It represents an undulating surface in which the "mains" are placed at the lowest

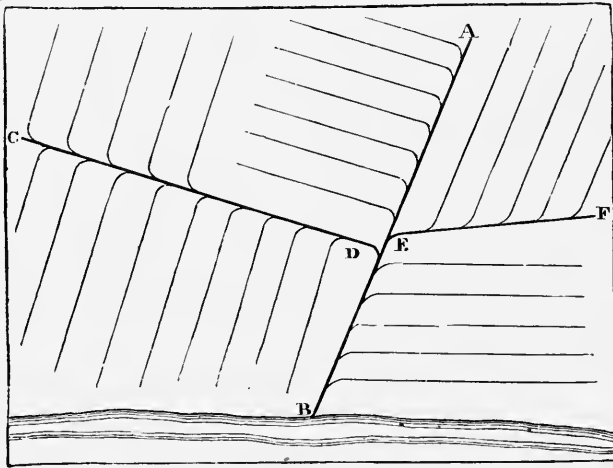


Fig. 373.—Plan of Drainage.

levels, and the minor drains run into them in the direction of the inclinations of the ground.

*The Depth of the Drains.*—This is decided by a variety of circumstances. It is usual in many cases to dig a series of holes called "test holes" in the field; or, if preferred, deep cuttings may be made; these should be dug in the line of intended drains, in order to become ultimately available as drains. Mr. Bailey Denton, one of our leading modern authorities on drainage, states, with reference to test holes, that they are only trustworthy when applied to light or free soils, and that they afford no index to what is required in the drainage of heavy clay soils.

The great object to be kept in view, in deciding the depth of drains, is to allow that depth which draws the greatest amount of water from the widest extent of land on each side of the drain. The greater the number of cubic yards of soil drained, the more perfect is the drain;



and this is, in fact, a test of the work. Or, as Mr. Parkes puts it, this is the true expression of the work done, as a mere statement of the cost of drainage per acre of surface conveys but an imperfect idea—a very erroneous idea—of the substantive and useful expenditure on any particular system.

*The distances between the drains* is a point which has been as keenly disputed as the depth to which they should be cut. It is obvious that circumstances of soil must decide the distances between, as well as the depths of, the drains. The distance which suits a light free soil will not suit a close heavy one. Much practical evidence on the depths and distances of drains was given in a Parliamentary Report, from which the following extract is taken:—

“The circumstance which has the most influence in ruling the distances of drains, and through these in some degree the depths, is the arrangement of the existing ridges. The width of the ridges runs generally from 12 to 24 feet, most commonly 18 feet; and as the ridges are usually thrown up in the middle from 12 to 18 inches above the levels of the furrows, a great saving in the cutting is effected by placing the drain in the line of the furrow; and besides, when the ridges are much raised, there is a tendency of the surface water to run towards the old furrow, even after the land has been drained; and if there is not a drain below or near to the furrow, there is an undue collection of water, which obtains for some years after the drainage has been executed, and until the ridges have been levelled down and the subsoil fully opened. The loss by this wetness or damp, or incompleteness of thorough and uniform dryness, is greater than the cost of having the drains somewhat less distant. There is also some difficulty practically in getting the drains cut to uniform depths, when the surface in the lines of the drains is of various altitudes from the datum level of the bottom of the drains.<sup>1</sup> Practically, therefore, it is found to be a much more ready method, and upon the whole cheaper and much more immediately fully effective, to adopt the furrows for the lines of the drains. In some cases, when the ridges are under 12 feet in width, I have found it expedient to place a drain in every second furrow only; and in cases where an inequality in the width of the ridges existed, I have found it proper to adopt those unequal distances for the drains. Where such distances have been adopted generally, it has been found that depths of from 2½ to 3 feet have, on all soils, and at all times, produced a thoroughly dry condition of the soil.”

*The Materials used in the Construction of Drains.*—Stone drains may be made where stones are very plentiful. Fig. 374 shows a mode of filling up a drain with stones; *a b* the trench, *c* stones on edge, *d* small stones, *e* a turf or sod, *f* soil. Fig. 375 shows the almost obsolete mode of filling up drains with horse-shoe tiles; *a b* the trench, *c* the “sole,” on which the tile (*d*) rests. These “tops and bottoms” are the

<sup>1</sup> This a good drainer overcomes by finding the proper level by means of the flow of water. Where there is no water in the soil to act as an indicator, it is necessary to use a proper instrument for ascertaining the level.

best tiles where the subsoil is a running sand. A mode of filling up drains, that has found considerable favour, is the "tube" drain, fig. 376; *a b* the trench, *c* the tube (which, in the diagram, should lie at the bottom of the drain), *d* the filling up of soil, &c. In most cases the tubes are placed in the trench simply end to end; in other cases the end of each drain-pipe fits into the expanded end (socket) of the succeeding one.

It seems to be generally admitted that the 1-inch bore pipe-tiles are not to be depended upon for drains, being very apt to become clogged, and not to afford a sufficient channel for the water. Plain cylindrical pipe-tiles are, however, the best that can be employed. For strong lands, and where the drains are frequent, a bore of 2 inches in diameter

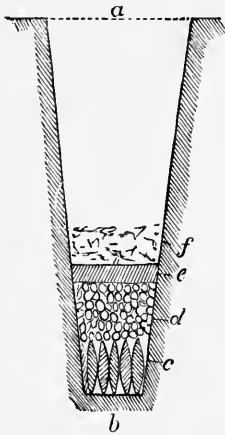


Fig. 374.

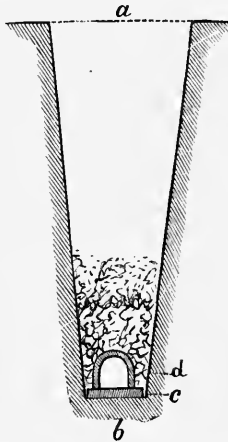


Fig. 375.

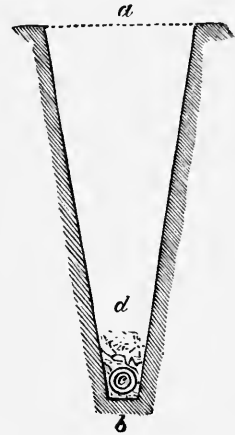


Fig. 376.

#### Different Methods of Filling up Drains.

will be found sufficient, and the size of the pipe may be increased as it approaches the outfall. For deeper drains in friable subsoils a bore of nearly twice that size will be requisite. The pipes for the main drains must always be capable of carrying off the water from all the pipes which discharge into them.

The following remarks on various points of detail in laying down drains, from an able Essay in the "Transactions of the Highland and Agricultural Society of Scotland," will be useful here:—

"In laying out the main drains and outlets, therefore, care must be taken to calculate with as great certainty as possible the quantity of water likely to be discharged. To determine the capacity in square inches of any circular pipe, square the diameter, and multiply by 0.7854. For example, a pipe having the diameter of 12 inches will, when square, equal 144, and this, multiplied by 0.7854, will give 113.0976, or a little more than 113 square inches. The discharging power, however, of these large circular pipes is much greater than a square or horse-shoe tile drain of equal sectional area. There is little

friction in the interior, and this, taken along with the contraction of channel, gives the water a much faster current in circular than in any other kind of drains. Even in ordinary main drains, tiles of a round or a reversed elliptical section should always be preferred to those that are flat-bottomed. The flow of water in any kind of under-drains, but especially in main ones, is also greatly dependent on the accuracy with which the levels are kept; and a very slight fall, if the bottom is cleaned out with a very great nicety, will give a good run, when a considerable fall with inaccurate levels will fail to secure this end. In cases where main drains have a long stretch without a discharging outlet, and run some risk of being flooded during heavy rains, it will be found conducive to their safety to provide at different points, if possible, a line of pipes branching off into some adjoining open ditch, which, while too shallow to receive the discharge from the main drain itself, may yet be low enough to catch the overflow water that is likely to do harm if not allowed an exit. Suppose, for instance, that a main drain 4 feet 9 inches deep is provided with a branch pipe at intervals, laid  $3\frac{1}{2}$  feet under the surface, it will be obvious that the vertical pressure on the former can never exceed 15 inches; and when the nature of the ground permits of it, may be so arranged as to be a great deal less. To catch any solid matter which may be likely to get into the main drains, it is always a safe provision to form, at intervals of 180 to 200 yards, small sediment wells, with brick on bed. A depth of a foot below the level of the drain will be sufficient in ordinary cases; and the building being carried up to within about 18 inches of the surface, a flat closely-fitting stone with a ring in it will cover up the opening. Wherever there is an overflow branch tile, there should be one of these wells in the main; and those that may be necessary at other points can have a mark set up near them, that the cover may easily be reached, and the well cleaned out at pleasure. In practice this will be found to add greatly to the efficiency of the drains; and the expense of providing wells such as have been described is very trifling.

“Another provision well calculated to promote the continued efficiency of outfalls and main drains is that of providing some sort of protection at the various mouths. A grating is sometimes placed before the vent, but the water is necessarily obstructed by it to an injurious extent; and, whenever drains are to be finished in the best possible manner, a light cast-iron valve, working on pivots, should be furnished for each outlet, in preference to a grating. By a number being placed on the valve, and a reference made to it in the drainage book, there is less fear of the outlet being forgotten than would otherwise be the case. How often, even on well-drained land, do we see the entire efficiency of the drains hazarded by the outfalls being neglected. The principal main drain is perhaps run into an open ditch; but, beyond putting a turf or two round the tile, no special building is provided to mark the place. As the ditch grows up from want of attention, the drain mouth is concealed, and by-and-by it

becomes choked altogether, and destroys the drains. Now, if a substantial stone or brick-built mouth, in the form of a very short culvert, were in all cases put round the farthest out-tile, a little valve provided, and its exact position and everything else described in a book kept for the purpose, it could scarcely be lost sight of, except under the grossest mismanagement. Care should also be taken, in every instance in which the ground at all permits of it, to give a drop of 9 or 12 inches from the sole of the outmost tile to the bottom of the open ditch."

As to the cost of draining operations, much need not be said, as this will depend upon a variety of local circumstances; consequently the results of experience at one place will be no guide to the probable results at another. "The principal circumstances," says Mr. Spooner, "which determine the cost of drainage works are: The labour of cutting and filling the drains, the material of which the drain itself is formed, and the outlets for the discharge of water. Of these, the last increases in proportion as the ground is steep and irregular or unusually flat, and can only be included in a general estimate where the surface gently undulates; the material also varies greatly in cost, arising, in the case of tiles, in the supply being near at hand and equal to the demand or otherwise, and, in the case of stones, in the distance of carriage.

"It was formerly considered that the cost of drainage was equally divided between that of the labour and material; and in 2½ to 3-foot drains filled with stones or horse-shoe tiles, on soles, this is about the case; but the more general introduction of pipes, and the improved methods of making them, have occasioned a considerable balance in favour of material, while increase of depth has increased the cost of labour.

"This latter item can be determined with sufficient accuracy by referring it to a standard pretty generally known, viz., the value of moving a solid yard of earth of any one description of hardness; and to illustrate this I have drawn up the following table, which supposes two sets of drains, the one open for stones, the other for tiles, and at depths of 3 feet, 3½ feet, and 4 feet respectively. I have shown the average width of the cutting for each size and sort, the number of lineal yards required to equal a solid yard in each; and assuming three descriptions of soil, the differences in hardness of which make the cost of moving their solid yard 4*d.*, 6*d.*, and 8*d.* respectively. I have calculated the labour value per yard and per rod linear of the different depths and sorts: and these will be found to tally very closely with the prices at which the work is done.

"It is a common remark that the cost of making drains is double by every foot of increased depth given, and the same in proportion for every part of such increase. The following table shows that this is so:—

STONE-FILLED DRAINS AS IN FIG. 374.

Depth of each drain in feet.	Average width of drain.	Running yards of drain to the cubic yard.	Sandy soils, light loams and light clays, easy digging.		Stiffer clay and gravel requiring some pick-work.		Hard clay and close soils requiring pick-work before they can be done.	
			At 4 <i>d.</i> per cubic yard.		At 6 <i>d.</i> per cubic yard.		At 8 <i>d.</i> per cubic yard.	
			Per yard.	Per rod.	Per yard.	Per rod.	Per yard.	Per rod.
4	14	2 +	<i>d.</i> 2	<i>d.</i> 11	<i>d.</i> 3	<i>s.</i> <i>d.</i> 1 4½	<i>d.</i> 4	<i>s.</i> <i>d.</i> 1 10
3½	12	2½ -	1¾	9	2¾	1 1¼	3½	1 5½
3	10	3½ +	1½	6½	1¾	0 8½	2½	1 0½

TUBE OR PIPE-FILLED DRAINS, AS IN FIG. 376.

			<i>d.</i>	<i>d.</i>	<i>d.</i>	<i>s.</i> <i>d.</i>	<i>d.</i>	<i>s.</i> <i>d.</i>
4	10½	2½ +	1¾	9	2¾	1 1¼	3½	1 5½
3½	9½	3¼ -	1¾	7	1¾	0 10¼	2¾	1 2
3	7½	2½ +	0¾	4½	1½	0 6½	1½	0 8¼

“Where a fraction more or less than the number stated is due, the signs - or + are put respectively.”

Suppose drains to be made 3 feet deep, and cutting and filling costs 7*d.* per rod, then the

COST PER ACRE AT DIFFERENT WIDTHS WILL BE :

	18 feet apart.	21 feet apart.	24 feet apart.	27 feet apart.	30 feet apart.	33 feet apart.
	£ <i>s.</i> <i>d.</i>	£ <i>s.</i> <i>d.</i>	£ <i>s.</i> <i>d.</i>	£ <i>s.</i> <i>d.</i>	£ <i>s.</i> <i>d.</i>	£ <i>s.</i> <i>d.</i>
Cutting and filling	4 5 2	3 12 11	3 4 2	2 16 7	2 11 4	2 6 6
Pipes, 14 in. long and 2 in. diameter, at 25 <i>s.</i> per 1,000	2 11 10¾	2 4 5½	1 18 10½	1 14 6¾	1 11 1	1 8 3½
Allowance for mains and outlets	0 3 6	0 3 9	0 4 0	0 4 3	0 4 6	0 4 9
Pipe-laying, at ¾ <i>d.</i> per rod (5½ yards)	0 9 1½	0 7 10	0 6 10½	0 6 0¾	0 5 6	0 5 0
Cartage	0 4 3	0 4 0	0 3 6	0 3 3	0 3 0	0 2 9
Superintendence	0 4 9	0 4 6	0 4 3	0 4 0	0 3 9	0 3 6
Total	£ 7 18 8¼	6 17 5½	6 1 8	5 9 11½	4 19 2	4 10 9½

The cost per acre, it is seen, ranges on the above scale from 4*l.* 10*s.* 9½*d.* at 33 feet apart, to 7*l.* 18*s.* 8¼*d.* at 18 feet apart. Deeper drains in hard soils will cost more in cutting; but upon easy digging soils 3-foot drains will be accomplished at considerably less than 7*d.* per rod. A great deal depends, however, upon the rate of wages.

In calculating the cost of executing drainage, the following table, given in the "Report of the Board of Health's Minutes of Information on the Drainage of Buildings, Sites, and Roads," will be useful. The cost of cutting drains obviously depends upon the quantity of earth thrown up, and the nature of the material to be excavated. To ascertain the cubic contents of a drain, multiply together the length, depth, and mean width of the drain. The mean width is half of the sum of the width of drain at the widest, and that at the narrowest part; thus, if the width at top is 18 inches, and width at bottom 4 inches, half of  $18 + 4$ , is the mean width. The following is the table above referred to:—

Depth. Inches.	MEAN WIDTH.											
	7 in.	8 in.	9 in.	10 in.	11 in.	12 in.	13 in.	14 in.	15 in.	16 in.	17 in.	18 in.
	C. yds.	C. yds.	C. yds.	C. yds.	C. yds.	C. yds.	C. yds.	C. yds.	C. yds.	C. yds.	C. yds.	C. yds.
30	0·89	1·02	1·14	1·27	1·40	1·53	1·65	1·78	1·91	2·04	2·16	2·29
33	0·98	1·12	1·26	1·40	1·54	1·68	1·82	1·96	2·10	2·24	2·38	2·52
36	1·07	1·22	1·37	1·53	1·68	1·83	1·98	2·14	2·29	2·44	2·60	2·75
39	1·16	1·32	1·49	1·65	1·82	1·98	2·15	2·32	2·48	2·65	2·81	2·98
42	1·25	1·42	1·60	1·78	1·96	2·14	2·32	2·49	2·67	2·85	3·03	3·21
45	1·34	1·53	1·72	1·91	2·10	2·29	2·48	2·67	2·86	3·05	3·24	3·43
48	1·42	1·63	1·83	2·04	2·24	2·44	2·65	2·85	3·05	3·26	3·46	3·66
51	1·51	1·73	1·95	2·16	2·38	2·60	2·81	3·03	3·25	3·46	3·66	3·89
54	1·60	1·83	2·06	2·29	2·52	2·75	2·98	3·20	3·44	3·66	3·89	4·12
57	1·69	1·93	2·18	2·42	2·66	2·90	3·14	3·36	3·66	3·87	4·11	4·35
60	1·78	2·03	2·29	2·54	2·80	3·05	3·31	4·38	3·82	4·07	4·33	4·58

Along the top of the table is placed the mean widths in inches; and in the left-hand column are the depths of the drains, extending from 30 inches to 5 feet. The numbers in the body of the table express cubic yards per rod. In making use of the table, it is necessary, first, to find the mean width of the drain from the widths at the top and bottom.

Thus, if a drain 3 feet deep were 16 inches wide at the top and 4 inches wide at the bottom, the mean width would be half of 20 ( $=16+4$ ), or 10; then, by looking in the table for the column under 10 (width), and opposite 36 (inches of depth), we find the number of cubic yards in each rod of such a drain to be 1·53, or somewhat more than  $1\frac{1}{2}$  cubic yards. If we compare this with another drain 20 inches wide at the top, 4 inches wide at the bottom, and  $4\frac{1}{2}$  feet deep, we have the mean width 12; and looking at the table under 12 and opposite 54, we find 2·75 cubic yards, or two and three-quarters to the rod. In this case the quantity of earth to be removed is nearly twice as much as in the other, and hence, as regards the digging, the cost of the labour will be nearly double. But in the case of deep drains, the cost increases slightly for another reason, namely, the increased labour of lifting the earth to the surface from a greater depth.

The following table is introduced as showing the number of rods to be laid, and the number of pipes required per acre, with drains at various distances apart:—

Distance between the Drains.	Rods (5½ yds.) per acre.	12-inch pipes.	13-inch pipes.	14-inch pipes.	15-inch pipes.
Feet.					
15	176	2,904	2,630	2,489	2,323
18	146	2,420	2,234	2,074	1,936
21	125	2,074	1,915	1,778	1,659
24	110	1,815	1,676	1,555	1,452
27	97	1,613	1,489	1,383	1,290
30	88	1,452	1,340	1,244	1,161
33	80	1,320	1,219	1,131	1,056
36	72	1,210	1,117	1,037	968
39	67	1,117	1,031	957	893
42	62	1,037	958	888	829

“Drainage alone,” remarks Mr. Sutton, “will go a long way towards turning a marsh into a profitable pasture, and it renders other improvements possible at a trifling expense. No undrained land should be laid down to grass. Otherwise careful tillage, costly manures, and the finest grass seeds will certainly be wasted. The result is only a question of time. Sooner or later the valuable grasses which are sown will be supplanted by sedge and rush and other semi-aquatic vegetation, until the pasture gradually deteriorates to the worthless state into which undrained land invariably falls. It is a safe general rule not to make any single drain too long, and plenty of fall should be given, or the pipes may not work well after they have been laid some time. A good fall renders them to a considerable extent self-cleansing, and the small drains should not enter the large drains at right angles, but always obliquely, so that the water may retain the momentum received in its previous career. Then the occasional flushing after a sharp storm will prevent the pipes from becoming choked. For short distances near hedgerows or trees, the use of socket pipes securely jointed with cement—not clay—is to be strongly recommended. The slight additional expense may save a large subsequent outlay. As to the depth at which the pipes should be laid, and the distance between the rows, no definite rule can be laid down. Experience has proved that in heavy land they must be near together, and not too deep; but in lighter land the lines may be comparatively far apart. About three feet deep with the rows fifteen feet apart is the usual proportion, but almost every field has some peculiarity of conformation or subsoil which affects the question. After the pipes are covered in, one man should always be held responsible for periodical examination of the outlets, to ensure their being kept in working order. Sometimes there is an indurated pan, or hard mass, formed beneath the cultivated surface by the weight of the plough and the horses’ feet through a long series of years. A similar condition resulting from natural causes is found on some heath lands, four or five inches below the surface. These hard subsoils are as impervious to water as beds of cement. Before putting drain-tiles into such land an experiment should be made to ascertain whether satisfactory drainage cannot be obtained by breaking up the

subsoil to a sufficient depth. If the trial prove successful, the expense of putting in tiles may be saved, and the fertility of the land will be increased. But in many cases it will be necessary both to break up the subsoil and to put in pipes before effectual drainage can be secured."

Having succeeded in draining the land, the next point for the consideration of the agriculturist is, the use to which he can apply the drainage water. That coming from high ground can often be applied to the irrigation of grass-lands situated at a lower level. When the land drained lies low, the centrifugal pump may be of use in raising the water for the purpose of working machinery, or an ordinary water-mill will effect the same object. The ingenious Shone system of pneumatic drainage may be even more advantageously applied. Or, if water-power is not required on the farm, the drainage water may be filtered, and applied to various useful purposes about the house or homestead. Here, as in all other agricultural operations, nothing should be wasted, but an endeavour made to derive the utmost benefit even from that which at first sight would appear to be valueless or mere refuse.

The composition of drainage waters is a subject of high practical importance. It has been investigated with extreme care at Rothamsted, and the results are recorded in various volumes of the *Journal of the Royal Agricultural Society of England*. A general *résumé* will be found in Dr Fream's little book <sup>1</sup> "Soils and their Properties."

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## CHAPTER XII.

### ON IRRIGATION.

**W**ATER, although injurious to land when it lodges in or stagnates upon it, produces a salutary effect where the land can be flooded and dried at pleasure. The knowledge of this has given rise to the practice of watering meadows, a system adopted, wherever circumstances admit of it, under the name of "Irrigation."

This practice, which was not introduced into England until nearly the end of the seventeenth century, has been in use from the earliest periods of history. The oldest book in the world gives an account of it: Moses speaks of the children of Israel, when in Egypt, sowing their seed and watering it with the foot.<sup>2</sup> They raised the water

<sup>1</sup> "Soils and their Properties." By W. Fream. London, George Bell & Sons. 2s. 6d.

<sup>2</sup> Deut. xi. 10.



of the Nile by means of machines which they worked with their feet, and poured it over their fields in places to which the inundation did not reach, or in seasons of the year when, in that hot country, water was necessary to the continuance of vegetation. These *sakias* still exist. The Greeks and Romans also practised various methods of watering their fields, as is evident from passages in the writings of Virgil, Cato, Columella, and Pliny. At the present day, in Southern Asia, the watering of land from rivers and brooks, and, if no better source can be obtained, from wells, is essential to the support of the inhabitants. In every part of southern Europe the water is conveyed in little channels to the corn-fields, the vineyards, and the olive-trees. In the western portions of the United States, as well as in parts of Australia, irrigation is rapidly increasing in favour.

The system of irrigation practised in Britain may, in a very few instances, be intended to supply the natural deficiency of moisture in the soil; but, generally speaking, a different purpose is to be answered. The water flows over the meadow at seasons when there is already a supply of moisture. It flows over it, but is not permitted to stagnate upon it, or the plants would be rendered in some degree aquatic. It often apparently contains no fertilising material. There is no rich mineral sediment. It merely flows over the land for a while, and is then carried off as quickly as it entered, and many persons are inclined to attribute the beneficial effects resulting from irrigation simply to the refreshing influence of the current; while others, on the contrary, conceive that the water contributes warmth to the soil and thus benefits it; but more scientific reasoners consider that irrigation is most fertilising where the chemical ingredients held in solution by the water are such as most readily affect the component parts of the soil. Pure water is seldom so beneficial in its action as water which is impregnated with organic or earthy matter. Certain it is that these considerations have not hitherto been sufficiently attended to, or it would have ceased to be a problem why irrigation should be so successful in one place and such a failure in another.

The ordinary mode of watering meadows may be briefly described. Suppose a stream of water lying contiguous to and somewhat lower than a river, adjacent to the field to be watered: a dam is thrown across the stream, or a sluice is dug in the bank, communicating with a channel or head main in the highest part of the field, which is filled with the water until its banks overflow. From this there run certain trenches, or small mains, called *carriers* or *carriages*; these are filled until they run over throughout the whole length. Drains are made in the lowest part of the meadow, as nearly parallel with the small drains as possible; the purpose of which drains is to discharge the water into a tail or main drain, which conveys it off the meadow.

In order to make the water run uniformly over the sides of the trenches, stops are placed in them at proper distances, which, by obstructing the course of the water, cause it to rise a little and overflow the neighbouring ground to a greater or less extent. These stops are formed by laying across the trench pieces of turf, which reach as

high as its banks next the sides, but are lower towards the middle; and, when they are of a proper height and distance from each other, the water will flow uniformly over all parts of the bank.

The trenches should be made with a small ascent in the bottom, from the river to the farther end, and should all unite near the river, where a sluice should be placed with gates or hatches. This being shut, in order to keep back the water coming from the river, and a small sluice in the side—communicating with the main drain of the canal—being opened at the same time, the water in all the trenches or mains will, to a greater or less extent, return from the farther end, and, passing through this small sluice into the main drain, leave the trenches, in a short time, perfectly dry. The bottoms of the drains are, on the contrary, to be made highest next to the river, and thence deepened to a large drain at the lower end of the meadow; so that, when the water ceases to run into them over the sides of the trenches, they will soon be emptied into the main drain, and the whole meadow thus be laid dry.

When the meadow is to be watered again, the small sluice must be shut and the large one opened, which will admit the water from the river, and irrigate the meadow as before. The water should be made to flow over the sides of the trenches, and over the surface of all the land lying between them and the drains, as equally as possible; and, for this purpose, the earth dug out of the drains and trenches at first, and afterwards when they are scoured or cleansed, should be spread upon the lower part of the ground, in order that it may lie evenly and form a regular descent towards the drains. The soil, thus dug or scoured out, also serves to repair the banks of the trenches. The land should be as level as possible, and where the surface is very uneven, the inequalities should be removed; for, although the expense of doing this is considerable, it will be more than counterbalanced by the value of the improvement.

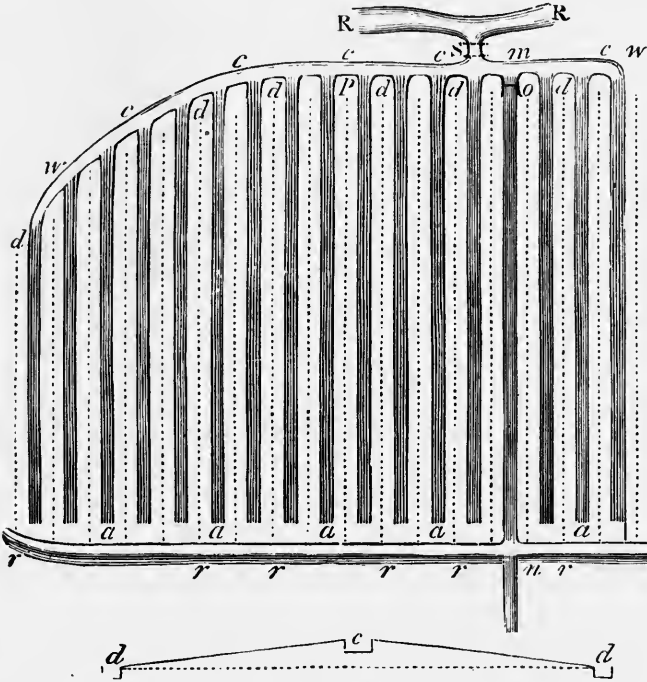
The construction of sluices is one of the principal items of expense, partly because they are usually made of timber, a material subject to decay in the course of a few years; whereas brick and stone, cemented together, are equally suitable, and would be much more durable, particularly when the sluices are constructed upon correct principles, so as to prevent them from being *blown up*, or the water from forcing a passage at the bottom. Great improvements have latterly been made in conducting this operation. The land is more carefully prepared, levelled, and inclined; the trenches, drains, &c., are better constructed, as are the sluices. In the Hampshire water meadows, sliding water-doors, regulated by a cog-wheel, turned by a movable winch, have been introduced.

It would be beyond the scope of this work to detail the mode of constructing the sluices, stops, &c., necessary in the system of flooding land. We shall, therefore, proceed to illustrate our remarks by the following plan and explanations, and at present need only observe that the different parts of the works should be carefully examined and scoured out in autumn, and all necessary repairs made. Much infor-

mation will be found in Mr. Boswell's interesting "Treatise on Watering Meadows."<sup>1</sup>

Fig. 377.—*w, c, c, w, a, a*, is the meadow, highest at *c c*, whence it has a slight gradual descent towards *a a*.

The whole meadow is divided into ridges, each about nine yards broad, which slope from the crown about thirteen inches towards the lower sides, or about one inch to every foot in breadth.



Figs. 377, 378.—Irrigation by Sloping Ridges (Ridge and Furrow).

*c c c* is the main carriage, which, when the meadow is to be flooded, is filled with water from the river *R R*, through a sluice at *S*. *c a, c a*, are carriages which communicate with the main carriage at the upper side of the meadow, whence they are also filled with water, which, running over the sides throughout their whole length, flows over the grass, and then, falling into the drains on each side, *d r, d r*, is conveyed into the drain *r r*, and from thence out of the meadow at *n*.

All the carriages of water-meadows should be broad enough to contain a sufficient quantity of water to flow over the whole surface of

<sup>1</sup> The reader may also consult Mr. Wright's Art of Floating Land; and will find some valuable hints on the subject in the Farmer's Calendar; the Agricultural Survey of Wiltshire; Stephens's Practical Irrigator; Thaër's Principles of Agriculture; Annalen des Ackerbaus, vol. ii.; Driver's Hampshire; and the Journal of the Royal Agricultural Society of England.

the land, and as quickly as the supply from the river will permit, for those meadows have been observed to be most fertile where the fall is quick, without being too sudden. To make the carriages deep would be of no use, because it is only the water at the surface that flows over their sides. A carriage kept full, that has only six inches of water, will throw as much over upon the meadow as if the water in it were six feet deep. There is also an evil in deep carriages; a larger body of water, by its weight, descends farther into the ridges and chills the land, and makes it produce flags and other aquatic weeds, to the detriment of the hay; whereas the object of the operation is merely to pass the water over the surface.

The drains *d r*, *d r*, are made in the furrows between the ridges, and parallel to the carriages; they are 18 inches wide, and of a similar depth, at the upper ends *d d*, and 24 inches wide, and the same depth, at the lower ends *r r*.

The carriages *c a*, *c a*, are widest (24 inches) at their upper ends *c c*, in order to receive a sufficient quantity of water, and are gradually contracted from 24 to 18 inches at their lower ends *a a*; by which contraction the water, being more and more confined, rises a little, runs over the banks, and flows upon the grass on each side.

The drains, on the contrary, being made narrower at their upper ends, and widening, and also deepening towards the lower, are on that account capable of receiving the accumulating water from the carriages, which they discharge into the large drain *r r*, in order to be conveyed out of the meadow at *n*.

The main drain *m n* is four feet wide, and is made to receive the water out of the carriages through a small sluice near *n*, which is to be opened for that purpose when the meadow has been sufficiently watered.

If the bottoms of the carriages were level from one end to the other, the water could not be drawn out of them, but would stagnate and chill the ground, making it produce sedges, flags, and other coarse aquatic plants; for which reason the carriages are deeper by six inches towards their upper ends next the river than at their further ends *a a*. This being the case, it results that, when the meadow has at any time been sufficiently watered, and is to be laid dry by shutting the sluice at *S*, to prevent more water coming in from the river, and opening the sluice near *n*, the water immediately begins to run out of the carriages into the main drains, all the former are emptied very speedily, and the water in the drains running off at the same time, the whole meadow soon becomes dry.

It is not necessary to continue the carriages so far as the drain *r r*, but they may be made shorter by three or four yards; for the water that runs over at the ends of the carriages will spread and flow over the intermediate spaces, from *a a* to the drain *r r*.

Where the water does not run over the sides of the carriages, or not uniformly, stops are to be put into the carriage a little below, which will make the water rise somewhat above the stops, and flow over the bank. These stops are made with pieces of turf laid across the

carriage in the style of a dam. The turfs are to be made higher than the surface of the water next the banks of the carriage, but a little lower in the middle, in order that the water may pass there.

The sluice S, by which the meadow is watered, is two feet wide, and three feet nine inches deep. While the meadow is being watered ("flooded" or "drowned"), the hatch or gate of the sluice is drawn up about  $2\frac{1}{2}$  feet, and then the water passes through an aperture of 5 square feet; by which means, supposing it runs at the rate of 2 feet in a second, the quantity of water thrown upon the meadow is 10 cubic feet in a second, or about 1,000 tons in an hour. A much larger quantity would be more advantageous, though even a less supply would benefit the land.

Fig. 378.— $d c d$  is a section of one of the ridges;  $c$  the carriage on the top of the ridge; and  $d d$  the drains into which the water falls after it has flowed over the land on each side from  $c$  to  $d$ .

If there is not sufficient water to irrigate the whole meadow at once, it may be done in two or more divisions. As, suppose the part  $w c m p$  on the right, or about half of it, is to be watered first, make a dam across the main carriage at  $c p$ , and then the part  $w o p$  may be watered in the manner described, and the other part will remain dry. In order to water this other part by itself, make a dam across the main carriage at  $o m$ , and at the upper ends of the other carriages from  $o$  to  $p$ ; the water being then let in from the river will fill the other carriages, and flow over this part of the meadow only.

The dams across some of the carriages may serve very well occasionally. Where, however, there is not a sufficiency of water, so that the meadow has to be watered in divisions, it is best to put in small sluices at convenient places in the carriages, in order to be able to turn the water on and off the several divisions of the meadow at pleasure.

When the water has flowed over the meadow, and is all discharged, any other meadows situated below  $n$  may also be flooded in the same manner as the first, and with the same water; and in some places it is thus thrown over several meadows in succession for some miles. But the fertilising ingredients of the water are diminished after it has been once used for irrigation, and the second or third meadow over which it is made to pass derives less and less benefit from it, the effect being in the latter case chiefly of a physical character.

Any meadows contiguous to a river may be watered without being laid out in so accurate a manner. If the river is a little higher than any part of such meadows, head mains may be made, and the water conducted to the highest parts, trenches or small mains branching from them between the drains. The nearer the trenches and drains are together, if there is room left to mow between them, the greater will be the advantage. Where there are any hollows, they should be filled up, and the surface made smooth with the earth dug out of the drains, in order that the grass may be mown very close.

There is another kind<sup>1</sup> of irrigation termed *catch-work*, practised in

<sup>1</sup> In 1850, Mr. Philip Pusey, in the "Journal of the Royal Agricultural Society of England,"

the West of England. It is suited to meadow and pasture lands that lie on a steep declivity, or on the side of a hill. This method is denominated *catch*, because, when the whole is watered at once, the water is carried up to the main cut or *feeder*, and, having attained the top of the piece of ground, floats over the uppermost pitcher, or *panes*, and is caught in or falls into the floating gutters which distribute it from one *pitch* to another, until at length it reaches the bottom of the field, where it is received into a drain made for the purpose of carrying it off, or conveying it to other lands situated on lower levels. In this method of watering, fewer channels are necessary than in the one previously detailed; and these are made as nearly in parallel lines below each other as the bank will permit.

In the plan, fig. 379, of a catch meadow, selected from Mr. Wright's

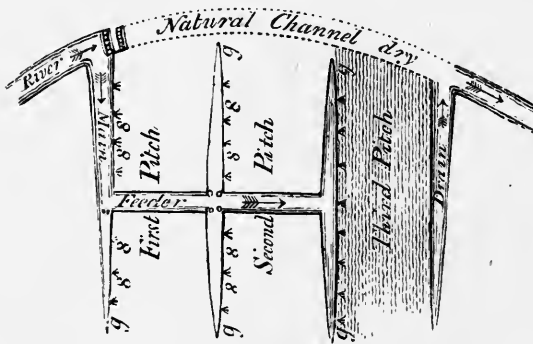


Fig. 379.—Plan of Catch-Water Meadow.

“Art of Floating Land,” the lateral, horizontal, feeding gutters, which distribute the water over the first and second *pitches*, are represented as shut by sods or stones, consequently they appear dry.” The whole body of water is indicated as passing down the main feeder into the lowest floating gutter, whence it reaches the bottom or third pitch, and is thence received into the drain at the bottom of the meadow, to be returned by it into the natural channel.

When the whole is to be floated at once, the obstructions are taken from the lateral floating gutters, other obstructions being in the meantime placed in the main feeder, immediately under the floating gutters, in order to force the water into them. In obstructing the main cut or feeder, care must be taken not to stop it entirely. A part of the water it contains should always be allowed to escape *in it* to the lowest panes or pitches; for, supposing the main feeder to be entirely shut under the feeding gutter (*g* 1), so that the whole is made to run over the first

wrote on the theory and practice of water-meadows, confining his remarks chiefly to the details of establishment and arrangement. He carefully distinguished between the water meadows of Hampshire, Wiltshire, Berkshire, Gloucestershire, and Dorset, and the catch-meadows of Somerset and Devonshire, and pointed out that the catch-meadow is as cheap as the water-meadow is expensive to form.

pitch from such gutter and the horizontal part of the main drain, the water which had percolated through the grass of the first pitch would be so largely deprived of its fertilising qualities as to be almost incapable of communicating any perceptible benefit to the pitches lying beneath. Water thus filtrated is, in the language of Gloucestershire irrigators, termed *used water*, and is regarded as next to *useless*: and hence it is that the grass growing nearest to the floating gutters is most abundant, and of the best quality, in all kinds of meadows. There is no doubt that the water does deposit a certain quantity of fertilising sediment, yet in many cases this is very small, and water from the clearest brook may be employed with very great advantage; though that from streams in which cresses and some few weeds grow is more beneficial.

The breadth of the panes or pitches of catch-meadows, from gutter to gutter, is by no means uniform; but it would seem that they ought not to be much broader than the distance from the floating gutter to the receiving drain in *float-meadows*—now most generally known as “ridge and furrow” irrigation—that is, from four to six yards. *Catch-meadow* is not held in such estimation, nor is it so profitable, as float-meadow, but it is the only kind available for hilly lands.<sup>1</sup>

All lands that lie low, and are contiguous to the banks of rivulets, brooks, and springs, are capable of being watered, particularly where the watercourse is higher than the lands, and is kept within its bounds by the banks. If the current has a very quick descent, the improvement by irrigation will be great, and attended with comparatively little expense, because, in proportion to the greatness of the descent, the improvement is more speedy. The lands most suitable for irrigation are, in Mr. Boswell's opinion—

1. A *gravelly*, or sound, warm, firm, sandy soil; or, which is more frequently the case, a mixture of each, or almost any soil partaking of these qualities. Such soils, where there is a descent from the river, exhibit an almost instantaneous improvement. It will in no case be advisable to attempt a large improvement by irrigation until the quality of the water is known. This, however, may in most instances be discovered by observing the effect it produces upon the herbage of the land which is sometimes overflowed by it; or may be ascertained by regularly watering a small piece of land with it. Water impregnated with ferruginous or calcareous particles is unfit for irrigation, as is peat and bog water; whilst trout-streams, brooks favourable to water-cresses, and springs which feel warm and soft, or, as some describe it, oleaginous, to the hand, are almost invariably found to be fertilising.

2. *Boggy*, miry, and rushy soils, which always occur near the banks of rivers where the land lies tolerably level, are capable of improvement equal to that of any others, when their respective values in an unreclaimed state are considered. In that state, indeed, swampy marsh-land is

<sup>1</sup> For an excellent paper on Catch-meadows, see Journal of the Royal Agricultural Society, vol. x., First Series.

of little worth; but, by judicious watering and draining, it may be made to produce an ample crop of hay. Much expense and judgment are, however, necessary to bring this sort of land into cultivation; and when it is very boggy, it requires more and longer watering than sandy or gravelly soils.

3. *Strong, wet, and cold clay soils* are the least susceptible of improvement from irrigation, not only because of the frequent dead level of their situation, but also from their tenacity, which will not admit of their being drained without great expense and trouble. But where the latter can be effected, and a strong body of water can be thrown over them from a fertilising river during winter, whilst a warm spring season follows, it has been stated that the crops of grass upon such lands are immense.

4. It may also be observed, that *springy land* is by no means suited to irrigation, until it has been rendered firm and compact by a thorough draining; for the water thrown upon it will soak into it, and cause it to produce, at best, only a coarse and rank herbage.

Water-meadows are of local rather than of general interest, and as such have seldom been made the subject of exhaustive inquiry. It is hoped, therefore, that the following brief account of a definite investigation which we made may present some features worthy of notice.

The land on the banks of the Christchurch Avon, a river rising in North Wilts, and flowing southwards through Wilts and South Hants to enter the English Channel at Christchurch, is extensively laid out in water-meadows. The particular meadows here noticed are on the western side of the river, in South Hants, about eight miles south of Salisbury. They lie upon a transported soil resting on the Upper Chalk. This soil has originated, partly, no doubt, from the deposits left by the river which has cut the valley, but chiefly from the rain-wash which has rolled down the slopes of the Chalk "Downs" on the west. This rain-wash consists of the aluminous and siliceous residue derived from the weathering of the highly soluble chalk-rock. The soil of the water-meadows, is in effect, a somewhat clayey loam, and, though it rests on the chalk, it is only in a slight degree calcareous.

The system of irrigation is intermittent, and is carried out by an arrangement of artificial water "carriers," varying from two feet to four or five yards in width, the feeding "carriers" occupying the summits of ridges, and the drainage "carriers" extending along intervening furrows. By means of sluices the "meads," as they are locally termed, can be flooded at will, and the water is allowed to remain on them for from three to fourteen days, and then they are dried for a period the duration of which depends upon local circumstances. This alternate flooding and drying goes on from September to March, when the meads remain unflooded for a month or more, in order that they may be grazed by sheep. Periodical floodings are then resorted to till the middle of June, after which the meadows are dried for mowing. Towards the end of July they are again flooded, and afterwards grazed by horses and cattle till September.



When flooded, the meads, viewed from a distance, hardly appear to be under water, but if walked upon they are found really to be more than ankle-deep. It is specially to be noted, moreover, that this water is running, and not stagnant. Beyond an occasional dressing of chalk, no application of manure is made to the meads, though of course they receive the excrements of such animals as are grazed upon them in the spring and autumn. Analysis has shown, however, that the water conveys to the growing herbage an appreciable amount of available nitrogen. At frosty periods the water has a higher and more constant temperature than the superjacent air, and since it is running water it is, furthermore, well oxygenated. The physiological effect of these two factors is to promote winter-growth, and even perhaps to permit of the persistence of some species of grasses which might otherwise die out.

The results of long-continued observation of the herbage of these Hampshire water-meadows are recorded in the "Journal of the Linnean Society (Botany)," vol. xxiv., 1888, and in the "Journal of the Bath and West of England Society, 1890." Our botanical analyses of carefully selected samples of the hay, taken in three different summers, yielded the following proximate results:—

—	1885.	1886.	1889.	Mean of the Three Years.
Gramineous herbage .	89·1	89·8	90·8	89·9
Leguminous herbage .	0·1	0·5	traces	0·2
Miscellaneous herbage	10·8	9·7	9·2	9·9
	100·0	100·0	100·0	100·0

A remarkable uniformity thus appears to prevail in the proximate constitution of the effective herbage of these water meadows. That samples of the dried herbage of the three crops of 1885, 1886, and 1889 should yield proportions of gramineous or grassy herbage varying less than 2 per cent. from each other, is an impressive fact. As shown by the figures of the last column, and as confirmed, moreover, by the figures of each year, it may reasonably be affirmed that the effective herbage of these water-meadows consists, in round numbers, nine-tenths of grass, and one-tenth of miscellaneous herbage, the leguminous herbage occupying an insignificant position. If this result is generally true—and it is only by sampling and separating the herbage for a number of years that it can be irrefragably established—the approximate uniformity of physical conditions under which the meadows are maintained would seem to be reflected in a corresponding uniformity in the general nature of the herbage with which they are clothed.

The next table shows not only what were the leading species of grasses found in the hay, but the actual weight per cent. which each contributed to the total hay:—

	1885.	1886.	1889.	Mean of the Three Years.
<i>Holcus lanatus</i> —Yorkshire fog . . .	40·6	26·3	36·8	34·57
<i>Lolium perenne</i> —Rye grass . . .	12·8	15·0	8·6	12·13
<i>Glyceria fluitans</i> —Sweet grass . . .	8·5	9·4	6·0	7·97
<i>Phleum pratense</i> —Timothy . . .	9·0	5·4	9·2	7·87
<i>Poa</i> sp.—Meadow grasses . . .	2·0	7·0	4·6	4·53
<i>Cynosurus cristatus</i> —Dogstail . . .	2·4	4·0	5·9	4·10
<i>Agrostis</i> sp.—Bent grasses . . .	3·3	4·8	4·0	4·03
<i>Glyceria aquatica</i> —Reed sweet grass . . .	1·4	2·2	4·6	2·73
<i>Festuca ovina</i> et var.—Sheep's fescue . . .	2·9	2·1	0·6	1·87
<i>Bromus</i> sp.—Brome grasses . . .	1·8	1·6	2·0	1·80
<i>Festuca loliacea</i> —Spiked fescue . . .	0·7	3·2	1·3	1·73
<i>Festuca pratensis</i> —Meadow fescue . . .	0·4	1·6	1·3	1·10
<i>Anthoxanthum odoratum</i> — Sweet vernal . . . . . } Other species, and undetermined grasses	1·1	1·3	0·6	1·00
	2·2	5·9	5·3	4·47
	89·1	89·8	90·8	89·90

The commanding position which is here assigned to Yorkshire fog is indisputable, and it may safely be said that, on the average, this species forms about one-third of the effective herbage of the water meadows. Rye grass comes next, though it yields little more than one-third as much hay as does Yorkshire fog, whilst it is almost twice as abundant as either of the next two species in order, floating sweet grass and timothy. Between *Poa*, *Cynosurus*, and *Agrostis* there does not seem much to choose, as, on the average, their yields are approximately equal, whilst the combined average yields of these three scarcely exceed that of rye grass alone. Neither the narrow-leaved nor the broad-leaved *Festucas* make much of a show, and *Bromus*, which is considerably in evidence when in bloom, takes a very modest rank in the haystack.

In addition to the foregoing the following species of grass are also found upon these water-meadows, but they collectively make up not more than about 5 per cent. of the total hay :—

*Aira cæspitosa* (tufted hair grass).  
*Alopecurus geniculatus* (floating foxtail).  
*Avena elatior* (false oat grass).  
*Avena flavescens* (yellow oat grass).

*Briza media* (quaking grass).  
*Phalaris arundinacea* (reed canary grass).  
*Phragmites communis* (great reed).  
*Poa annua* (annual meadow grass).

It has been proved in the Rothamsted experiments that the botanical composition of meadow herbage is highly susceptible to seasonal influences. Sir John Lawes and Dr. Gilbert have come to the conclusion (Phil. Trans. Pt. I. 1880, p. 405) that “a given quantity of gross produce of the mixed herbage may be one thing in one season, and quite another in another season, both as to the proportion of the different species composing it, and their condition of development and maturity.” Though the crop which the water meadows yield to the scythe does undoubtedly vary from year to year, it is nevertheless necessary to remember that there is a much greater

uniformity of conditions in the water-meadows than can possibly exist in ordinary non-irrigated meadows. Particularly is this so with regard to moisture. Year after year are the meads subjected periodically to the beneficent influence of running water, so that even in seasons of the severest drought the removal of the hay-crop brings to view a sward which is bright, fresh, and verdant. This was specially noticeable in the hot droughty summer of 1887, for whilst, at the end of July, the ordinary meadows of the district were bare and scorched, the water-meadows carried a luscious green aftermath, and afforded good grazing for milch cows. Thus, whether the season be wet, or dry, or of average rainfall, it is much the same to the water-meadows, inasmuch as the system of irrigation renders them largely independent of the rainfall. On the other hand, variations in temperature and in the duration of sunshine are probably as operative on the water-meadows as on other grass lands, and it is in this direction that seasonal differences are most likely to prove effective. Assuming, moreover, in accordance with the researches of Boussingault, Gilbert, Risler, and Hervé-Mangon, that it requires a certain total amount of heat above an ascertainable minimum temperature to ripen the seed of any given plant, this amount will be the earlier acquired the hotter the season. More seed of certain species of plants will consequently ripen and fall to the ground, and, so far as these species are concerned, they may gain an advantage in the struggle the full effects of which will not make themselves apparent till the following season.

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## CHAPTER XIII.

### ON WARPING.

**T**HE practice of *warping* is extensively pursued in certain districts.<sup>1</sup> It consists in directing upon the land the tidal overflow of large rivers, suffering it to deposit the sediment or *warp* which it contains, and then letting the water run off again as the tide ebbs. The water is admitted by sluices into a still pond, or over a convenient area of country. An embankment preserves it in a great measure from the agitation of the waves, and the earthy matter which the water contains is thus deposited. On the banks of the Humber this operation has long been practised on a most extensive scale. The water is there more than usually turbid, on account of the meeting of the tide and the fresh water. The tide runs for a considerable way inland, and in

<sup>1</sup> Mr. Ralph Croyke, of Rawcliffe, near Goole, appears to have been the pioneer of artificial warping. He obtained a private Act of Parliament in 1821, and led the warp quite three miles by "canal."

the course of a season a foot of rich soil is, on an average, added to the former surface, and, in low situations, two or three or four feet, so as to have a perfectly level surface.

In order to render this process more efficacious, the water must be perfectly at command, so that it may be excluded or admitted at pleasure; and the land should be below the level of high tide. Hence it is necessary not only to cut a canal communicating with the river, but also to have a sluice at the mouth of it, which may be opened or shut as circumstances require; while, in order that the water may be of a proper depth on the surface of the ground to be warped, and also to prevent adjacent lands from being overflowed, strong banks are raised around the fields, from three or four to six or seven feet in height, according to circumstances. Thus, if the area is of considerable extent, the canal which takes the water may be made several miles in length. It has been tried as far as *four*, so as to warp the lands on both sides the whole way. Lateral cuts may be made in any direction for the same purpose, thus allowing the water longer time to deposit its sediment, for the effect decreases in proportion to the distance of the land from the river.

The following practical instructions for conducting the process of warping we give in the words of Mr. Thornton J. Herepath:—

“An excavation having been made in the river-bank, under the bed of the stream, a *clough* is built, which directly communicates with a main drain or duct. This drain is furnished with substantially-built raised embankments of very solid earth, and is formed for the purpose of conveying the muddy water from the river to the land intended to be warped, over which it is gradually and equally distributed by numerous smaller lateral drains, the said land having been previously laid as nearly upon a level as circumstances will admit. In order to confine the water to this particular spot, and prevent it from overflowing the adjacent country, the land is surrounded and divided into compartments by strong well-formed banks, which are of the same height as those of the main feeder, but neither so wide nor so solid. Then again, there is an inner bank all round, which has openings in it adjacent to the lowermost parts of the land, for the purpose of getting the muddy water to these places as soon as possible. In this way every flood-tide is conducted into every one of the compartments in succession, and as it ebbs, the hydrostatic pressure of the water alone suffices to force open the swinging doors of the return sluices, thus allowing itself to escape into the main canal and thence into the river, after having deposited nearly the whole of its mud upon the surface of the enclosed land. Of course, the higher the tides are, the greater is the depth of water to produce the deposit, and *vice versâ*. Considerable skill must be exercised in adjusting the size of the *cloughs*, so as to discharge the whole of the water before the rise of the next tide, as otherwise only every other tide can be admitted.

“By the above plan it has been found possible to warp land in one year to the depth of two or three feet, and this is generally considered to be quite deep enough, and is permanent in its action. This state-

ment, however, only applies to those lands which are sufficiently below high-water mark; where the level is higher, a longer time—often from two to three, or even sometimes four years—is required.”<sup>1</sup>

The effect derived from warping differs greatly from that produced by irrigation; the former being simply the deposition of mud from turbid water, by means of which a new soil of alluvial origin is formed. During floods, and also in winter, this business entirely ceases. Its tendency is not to *manure*, but to *create* soil; hence the nature of the land is a point of little moment, almost every soil, whether peat, sand, bog, or clay, but especially light land, being benefited by the process; and yet, as warped land must be kept well drained, the porous nature of peat and sand renders soils of this class best adapted for undergoing the amelioration, and the former even more so than the latter. An analysis of warp gave the following result—

	Per cent.
Organic matter . . . . .	7.003
Carbonate of lime . . . . .	9.775
Carbonate of magnesia . . . . .	1.520
Potash and soda . . . . .	0.035
Lime . . . . .	0.905
Magnesia . . . . .	2.684
Peroxide of iron . . . . .	4.465
Oxide of manganese . . . . .	traces
Alumina . . . . .	4.494
Perphosphate of iron . . . . .	0.092
Silicic acid (silica) . . . . .	68.778
Sulphate of lime . . . . .	evident traces

A remarkable instance of the beneficial effects resulting from the practice of warping occurred on the farm of Mr. Webster, of Bankside, which contained 212 acres, and was entirely warped. As evidence of the high value of this improvement, it may be stated, that he gave 11*l.* per acre for the land, for which he afterwards refused *seventy pounds* per acre. His total expenses for sluices, banks, cloughs, &c., did not exceed 2,500*l.*, or 12*l.* per acre; which may, indeed, be reduced to 1,000*l.*, or 5*l.* per acre, as a neighbour below him offered 5*l.* an acre for the use of his sluice and main cut, to water 300 acres. Estimating it, however, at the higher sum, 12*l.*, to this, the purchase-money, 11*l.* must be added, making the whole 23*l.* per acre; which, if he could sell at 70*l.*, leaves a profit of *forty-seven pounds* per acre, neglecting interest.

Mr. Webster warped to various depths, from eighteen inches to two feet, two feet and a half, &c. He had some moor land, which, previously to being warped, was worth only *one shilling and sixpence* per acre, but was afterwards as good as the best land; some of it let at 5*l.* for flax or potatoes, and the whole at 50*s.* an acre.

The practice of warping commences in the month of June, and is carried on throughout the summer; in fact, that is the only season in which the improvement can go on. Consequently the agriculturist should avail himself of every aid, and keep his works in

<sup>1</sup> Journal of the Royal Agricultural Society, Part I. vol. xi.

constant repair, in order that he may not lose the benefit of a single day. This method of ameliorating land is chiefly practised by the farmers residing on the banks of the Don, Humber, Ouse, and Trent, to whom it proves a source of substantial profit. But it might also be successfully adopted on lowlands adjoining rivers, the tides of which are often impregnated with mud. The land thus created, when of sufficient depth, is possessed of great fertility. It does not require manure; it admits of courses of cropping which no other soil could support; and, by merely keeping the sluices in repair, its productive powers can always be maintained in full vigour.

We conclude this chapter with the following particulars, supplied by Mr. T. C. Scholey, Eastoft Grange, Goole, Yorkshire:—

The water of the broad estuary of the Humber is profusely and uniformly mixed with a peculiar kind of yellowish mud called WARP. Some geologists regard this Warp as the waste of the Till of the Holderness coast. Others consider it to be the river silt “churned” up, and turned back by the tides of the Humber.

The Humber drains most of Yorkshire and much of several other counties, and receives incalculable quantities of the soil of these counties, which by the action of the tides is thoroughly mixed and deposited at the bottom and sides, and also in large sand banks in various parts of the area of this river.

This compound the Humber, by the force of its tides, conveys and reconveys to the lower portion of the Trent and Ouse, and also to the tributaries of the latter, from which thousands of acres of low, and in many instances quite worthless land, lying on the borders or inland, at distances varying from one to seven miles, have been covered one, two, and even three feet thick with Warp and converted into land of average quality and fertility; and yet, notwithstanding the fact that several thousand acres of such land have been made, requiring millions upon millions of tons of this deposit for its creation, the waters of these rivers are to all appearance as fully surcharged with Warp as they ever were.

The soil most frequently improved by Warping is peat, but any inferior land resting contiguous to any of the above-named rivers, and lying sufficiently low to admit of its being flooded to a depth of two to four feet, may be raised and greatly improved by the process.

In order to carry out these improvements three things are necessary. First:—That the land to be improved shall be situated within a suitable distance of one of the rivers referred to; secondly, a sluice at the river, to open and shut so as to take in the tides or keep them out at pleasure; and thirdly, a canal or “warping drain” to convey the water to and from the land to be warped.

The size of a warping sluice varies from six or eight feet square to twice these dimensions, and the width of the canal from thirty feet upwards. The largest sluice and canal ever made for this purpose is the one by which the principal part of the neighbourhood of Goole was warped; the former having two openings, each sixteen feet wide by twenty deep, through which numbers of vessels of nearly one hundred

tons burthen have passed, bringing cargoes of manure from Hull, London, and elsewhere, and taking out a return cargo of potatoes for the London and other markets. This canal is nearly one hundred feet in width, and is continued for a distance of about seven or eight miles, warping, and thereby converting bad land (chiefly peat) into good, on both sides its course.

When the land to be warped is not under cultivation, the necessary preparatious may be made at any time, but when the reverse is the case, it is of course needful to defer the work until after harvest, when the land is surrounded by an embankment varying in height from three to six feet, according to circumstances, the internal canals or inlets cut, &c. The area to be warped may vary from thirty to forty acres (a very primitive method) to three or four hundred, according to the size of the sluice and canal. All the necessary preparations having been completed, the doors of the sluice are thrown wide open at low water to the full force of the rising tide, which is conducted by the canal to the land to be warped.

When warp is in the rivers or warping canals it is impossible to distinguish its various constituents one from another, but as soon as the tide has reached the land and begins to spread itself over a larger area, the force of the current is very considerably weakened, and the heavier particles begin at once to fall to the ground; and whilst the medium are carried somewhat farther, the lightest float to the more remote portions of the inclosure.

One of the peculiarities of warp is that those particles which when in the water are heaviest make the lightest and most friable land, and *vice versa*. Hence it is highly necessary, when the water has reached the land, that a portion of it be confined in smaller inlets or canals, and thereby conducted to the various parts of the inclosure, before being allowed to expand over the entire area, by which means the warp is more evenly distributed, and a more uniform quality of land is the permanent result.

The length of time required for warping a piece of land depends on several circumstances, viz. : the thickness of warp it is necessary to lay on in order to raise the land sufficiently high to drain well in times of heavy and continuous rainfall; the distance the land lies from the nearest available supply; the state of the weather—dry seasons being the best, the tides then containing a larger percentage of warp than in wet ones; the area inclosed; and the capacity of the sluice and canal. The average duration of the process may be put down at from two to three years. In the spring and summer there is a larger proportion of warp in the water than in the winter, in consequence of the rainfall being usually much less in these seasons of the year. The “flood” tides—at the new and full moon—both in summer and winter, contain a far larger quantity of warp than the “neap” tides, owing to the greater volume of water that then comes up from the sea, the violence of which stirs up the warp that during the neap tides had partially settled at the bottom of the Humber. The work is performed at one or two operations, according to circumstances, the second warping taking place

after an interval of from five to ten years. The double process invariably makes the best finish of the land, but it is a great inconvenience to the occupier to lose the use of the land twice, to say nothing of the many heavy expenses that fall on him each time the land is given up to him by the Warpers, and has to be again divided into fields, old ditches re-opened, or new ones cut, and the land drained and put under a proper course of cultivation.



# BOOK THE TENTH.

## ON THE CULTIVATION AND APPLICATION OF GRASSES, PULSE, AND ROOTS.

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### CHAPTER I.

#### ON THE NATURAL GRASSES USUALLY CULTIVATED.

THE term Grass is commonly employed as embracing the whole of the plants growing in a meadow or pasture. Grass-land similarly indicates any land the crop upon which may be mown for hay, or grazed by stock. Even a cursory examination of the herbage of established pastures and meadows will serve to show that it includes plants of many different kinds. It is possible, and at the same time it is convenient, to arrange these, for purposes of study and examination, in three groups, embracing (1) grass plants, (2) clover plants, and (3) all other plants. The first group includes the true grasses, or gramineous plants, belonging to the natural order Gramineæ. The second group comprises the clovers, trefoils, &c., members of the natural order Leguminosæ. The third group embraces all the other plants, which are neither gramineous nor leguminous, and which are sometimes spoken of, in connection with grass-land herbage, as miscellaneous plants or "weeds." Such are buttercups, cuckoo-flower, chickweed, campion, ragged robin, silver-weed, earth-nut, daisy, dandelion, thistle, hawkweed, hawkbit, knapweed, yarrow, selfheal, yellow rattle, speedwell, plantain, dock, sorrel, rush, sedge, adder's tongue, and moss.

This chapter is restricted to a discussion of the true grasses, and mainly of the cultivated grasses, though some incidental references are made to the weed grasses. As introductory thereto it may be useful to the reader if we record a few facts respecting grasses as a group, and concerning the characters whereby grasses are distinguished from each other, and from the plants which most nearly resemble them.

The general structure of grasses will be best understood by examining a grass plant pulled up by the root. It is at once seen that the root consists of a large number of more or less coarse threads, called root-fibres. They serve to attach the plant firmly to the soil, and afford at the same time the means whereby the plant takes up, in solution, its food from the soil. This fibrous root of the

grass differs greatly in appearance from such a root as that of the carrot or radish, which is termed a tap-root. All grasses possess fibrous roots, as also do wheat, barley, oats, rye, maize, and millet, which are merely grasses cultivated for the sake of their grain.

The upright stem in a grass plant is called the culm. In most species the culm is hollow, save at the bases of the leaf-sheaths—the joints,—where it is solid. Many grasses develop a prostrate stem, or stolon, which at intervals sends rootlets downwards and leaf-shoots upwards, and thus gives rise to a number of independent centres of growth. Such grasses are described as stoloniferous; florin and couch grass are examples.

The leaf in most grasses is seen to be long, narrow, and strap-shaped, coming to a point at its free end. When held between the eye and the light, the leaf is seen to be traversed by a number of parallel ribs extending from tip to base. Traced downwards the leaf is found to embrace the stem, by means of its leaf-sheath. In most kinds of grasses the leaf-sheath is split down the front. By pulling the leaf slightly away from the stem, and looking at the place where the leaf joins its sheath, a thin whitish outgrowth is brought into view. This is the ligule, and it is worthy of note because, on account of variations in its size and shape, it is frequently of use in affording a means of distinguishing between grasses that are otherwise much alike.

The most characteristic features of grasses are to be found in the flowers, and for these the ear or panicle must be examined. To understand these characters it is desirable to take an ear of some large-flowered grass,—an ear of oats, for example. The nodding structures at the ends of the delicate branches are called spikelets. One of these spikelets should be broken off and examined. At its base are to be seen two large boat-shaped leaves—called the outer glumes—almost, but not quite, opposite each other. Between these outer glumes are embraced two or more little flowers,—or florets, as they are more appropriately termed, on account of their small size. Each floret is made up of two chaffy leaves, nearly opposite to each other. The larger and lower of these is called the flowering glume, the smaller and upper is the palea or pale. Between the flowering glume and pale are contained the three stamens, from the anther-lobes of which comes the male fertilising material, or pollen. In the heart of the flower, between the filaments, or stalks, of the stamens, may be seen the ovary, which eventually ripens into the grain.

In most grasses the florets are much smaller than they are in the oat-plant, and there exist various modifications of the parts just enumerated. In the wheat-plant, however, the florets are large, but the spikelets which contain them have no stalks. The presence or absence of stalks to the spikelets determines to a great extent the appearance of the ear or panicle of a grass. Where the spikelets are not supported by stalks, but rest directly upon the stem or axis, we get the close ear seen in wheat, couch grass, barley, barley grasses, rye, and rye grasses. Where the spikelets are upon long stalks which stand well away from the stem, such panicles as those of oats, oat

grasses, meadow grasses, fescue grasses, brome grasses, quaking grasses, and cocksfoot result. Sometimes the stalks of the spikelets are very short, and lie so closely against the stem, that the panicle looks as if the spikelets were without stalks, though examination shows this is not really the case; examples are seen in foxtail, dogstail, timothy, and, to a less extent, in sweet vernal. It may be noted that just as the ear or panicle of a grass or cereal is made up of spikelets, so is each spikelet made up of one or more florets.

The awns of grasses deserve the notice of the careful observer. The awn is a bristle which usually springs from the back of the flowering glume, above referred to as helping to enclose the floret. The awn may arise from the base, or from the middle of the back, or it may be a mere prolongation of the tip, of the flowering glume. "Bearded" wheat is awned, beardless wheat is not awned—or the awn is but slightly developed. Instances are subsequently mentioned in which the awns afford the means of distinguishing between species of grasses that are otherwise much alike.

Some explanation is necessary as to the so-called "seed" of grasses. In the middle of the perfect flower of any plant is a structure called the ovary, which contains one or more egg-like bodies termed ovules. After the ovules have been fertilised by the pollen from the anther-lobes of the stamen, the ovary matures into the fruit, and the contained ovule or ovules ripen into the seed or seeds. Thus, a pea-pod is a fruit, containing the peas, which are the seeds. Similarly, a cherry is a fruit, containing a kernel, which is the seed. A grain of wheat is a ripe fruit, and is equivalent botanically to the entire cherry or the whole pea-pod, for it is the mature ovary. To get at the true seed of wheat—that is, the ripened ovule—it is necessary to peel off the thin bran-like coats that, in this case, make up the wall of the ovary. As a matter of fact, the simple seed of cereals and grasses is never seen, the grain being really the fruit. The commercial "seed" of rye is similar to that of wheat, but in the case of barley or oats there is something more, for the flowering glume and pale have hardened on to the grain, so that the "seed" in this case is the dried floret, in the middle of which is the ripened ovule. The "seed" of many grasses, as it occurs in commerce, consists similarly of the entire floret, this being the case with the "seed" of cocksfoot, dogstail, fescues, rye grasses, meadow grasses, sweet vernal, timothy, and others. In some cases, the "seed" consists of even more than this, for it is constituted of the entire spikelet. An example is afforded in foxtail seed, to gather which it is only necessary to strip the spikelets off the ripe ear. Hence, the term "seed" as applied to grasses must be understood in a special sense,—the fruit or grain enveloped in "chaff"—and as by no means implying the true botanical seed, such as is exemplified in the commercial seed of clovers, trefoils, turnips, and cabbages. In short, the term "seed," as applied to grasses, means simply "that which is sown." Our thanks are specially due to Mr. Martin J. Sutton for permission to reproduce from his work "Permanent and Temporary Pastures," the illustrations of grass "seeds," given in this chapter.

Another word of caution is needed as to the occasionally incorrect use of the term "grass," it having been familiarly applied to a number of plants which are not members of the natural order Gramineæ. Thus, cotton grass is, as is subsequently mentioned, really a sedge; so is carnation grass (*Carex panicea*, L.) Knot-grass (*Polygonum aviculare*, L.) is a troublesome weed on arable land, and a near relation of the docks and sorrels. Goose-grass is the hariff or cleavers (*Galium Aparine*, L.) growing in hedgerows. Rib-grass is the plantain (*Plantago lanceolata*, L.). Scorpion-grass (*Myosotis arvensis*, Hoffm.) is one of the blue-flowered forget-me-nots. Arrow-grass (*Triglochin palustre*, L.) belongs to the water plantain family. Scurvy-grass (*Cochlearia officinalis*, L.) is allied to the horse-radish, and is a cruciferous plant, like the whitlow-grasses (*Draba* and *Erophila*). The grass of Parnassus (*Parnassia palustris*, L.) is a member of the beautiful saxifrage family. Cow-grass is a clover—the much-valued *Trifolium pratense* perenne.

The only commonly occurring plants which are liable to be mistaken for grasses (nat. ord. Gramineæ) are rushes (nat. ord. Junceæ) and sedges (nat. ord. Cyperaceæ). The rushes, however, usually have dark green rounded stems, tapering to a point, and enclosing a continuous or interrupted pith. The leaves, if noticeable, are either flat or like the stem. The brownish flowers of rushes contain six stamens, surrounded by six scaly leaves. They are, therefore, quite different from those of grasses, and have the structure rather of a very diminutive tulip flower. Moreover, the flowers are never aggregated together in spikelets. The true rushes (*Juncus*) grow naturally on poor wet lands. The wood-rushes (*Luzula*) occur upon heaths, meadows, pastures, and in shady places. Their foliage is more grass-like than that of the rushes, but their leaves always have a cottony appearance, due to the presence of long wavy white hairs.

The sedges (*Carex*) are at once distinguished from grasses by their solid triangular stems, by their entire leaf-sheaths, and by the absence of ligules. In grasses the stems are usually round and hollow, and their leaf-sheaths are split in front. The cotton-grass or cotton-sedge (*Eriophorum*), growing on moors and bogs, develops cottony heads, which look in the distance like tufts of white wool.

We proceed to offer some observations on the cultivated grasses, taking them, as a matter of convenience, in the following order:—Cocksfoot, Dogstail, Fescues, Fiorin, Foxtail, Meadow Grasses, Oat Grasses, Rye Grasses, Sweet Grasses, Sweet Vernal, and Timothy. Incidental references are made, in this section, to such weed grasses as are generically allied to any of the foregoing.

**COCKSFOOT** (*Dactylis glomerata*, L.).—No grass is more easily recognised than rough cocksfoot (fig. 380). Its spikelets are crowded together into thick clusters—hence the specific name, "glomerata"—and they are all turned to one side. It is a large, coarse-growing, and often unsightly plant, rough or harsh to the touch. The leaves are

very characteristic—broad, thick, juicy, bluish-green, and their basal parts white and flattened near the ground. It is tall, and of quick growth. After having been once mown, and particularly if it is growing in a deep, rich soil, its foliage becomes luxuriant and abundant. To this latter circumstance is attributed the freedom with which it grows in orchards (whence it is termed Orchard Grass in the United States), and near farm buildings. It is less suitable for pasture than for meadow, because on account of its tufted habit it forms dense cushions or tussocks, which, owing to the strength of the stems, render the whole plant liable to become uprooted by grazing animals. Its fibrous, much-branched, and deeply descending root, renders cocksfoot almost insensible to drought, provided it has a sufficiently deep soil. Though proof against the ordinary cold of winter, it is less indifferent to the effects of late frosts. It grows successfully in almost all soils,



Fig. 380.—Cocksfoot grass.  
*Dactylis glomerata*.



Fig. 381.—“Seed” of *Dactylis glomerata* (Rough Cocksfoot.)  
Front and side views,  
magnified 8 diameters.

except dry sands and heath lands. Generally, it thrives better in damp and heavy soils than in such as are light and dry.

Cocksfoot is never sown alone, for its tufted growth would result in the formation of a patchy irregular sward. It should be cut, if practicable, before flowering, otherwise the stems become hard and woody, and therefore less acceptable to animals as fodder. In meadows where cocksfoot makes up the chief part of the herbage, the time for commencing to mow should be determined by the condition of this grass. In reference to its quick growth there is a popular saying in the meadows of France and Switzerland, “Il recroît sous la faux,”—“It even grows under the scythe.” Of all grasses, this one furnishes probably the most abundant aftermath.

On account of the tufted growth of cocksfoot, the grasses specially recommended for sowing with it, in order to occupy the spaces, are perennial rye grass, foxtail, and timothy, with as much clover as may

appear desirable. It is in temporary leys, destined to remain for three to six years, that cocksfoot finds its most advantageous application. If, however, it is allowed to enter in too great a proportion into any mixture, the same inconvenient results follow as when it is sown alone, that is, it forms dense cushions or tufts, and so conduces to an irregular sward. It is, therefore, recommended to use in the first sowing rather less cocksfoot than appears to be necessary, and, after the other grasses have had some opportunity to establish themselves, to sow the remaining cocksfoot later. Only in exceptional cases is it necessary at first to sow cocksfoot in greater proportion than 15 per cent. of the mixture. Heavy rolling in spring is recommended, as thereby the projecting hassocks or tussocks are reduced to the general level of the sward. In old meadows, in a good state of fertility, it is often advantageous to send the harrow before the roller.

The commonest impurities of cocksfoot "seed" (fig. 381), namely, the seeds of meadow fescue, yellow oat grass, and rye grass, are far from being injurious, and two of them are of higher commercial value than cocksfoot seed itself. More prejudicial are the seeds of brome grass and of certain weeds of the composite family, particularly ox-eyes, groundsel, ragworts, nippleworts, and hawkweeds. Seeds of umbelliferous weeds are also found in badly-cleaned samples of cocksfoot. The grass seeds chiefly employed in the deliberate adulteration of cocksfoot are those of hard fescue (*Festuca duriuscula*), and blue molinia, or blue moor-grass (*Molinia cærulea*). But the seed of this fescue is distinguished from that of cocksfoot in that it is of a browner colour, and is more rounded on the back, which is not keeled. In *Molinia* the inferior of the two glumes of the seed is a little longer and more swollen than the equivalent structure in cocksfoot, whilst the contained grain is shorter and thicker, especially at the base.

**DOGSTAIL** (*Cynosurus cristatus*, L.).—Crested dogstail grass, though of sparse habit, contributes materially to the production of a good "sole" in the turf of pastures. It is essentially a pastoral plant, and is of less value in the hayfield, though the material known to London hay-dealers as "Hendon Bent" consists chiefly of dogstail, and is much appreciated as horse feed. In association with the narrow-leaved fescues dogstail is an important constituent of many of the best sheep pastures, whilst its withered culms may be seen in quantity at the fall of the year in old deer-parks. The appearance of the panicle is so characteristic (fig. 382) that it is not likely to be confounded with any other native species; its peculiarity is the presence of a pectinate bract at the outer base of each spikelet. The leaves are rather narrow and taper upwards, and the sheaths near the ground have a yellowish-white colour. Dogstail is widely distributed in the pastures of the British Isles, but it never occupies a leading place in the bulk of herbage produced. The plant seems to be most at home on compact dry soils, and is qualified to thrive above a chalk subsoil. The roots are hardy and penetrate deeply, hence dogstail is little susceptible to drought.

The "seed" of dogstail (fig. 383) is easily identified by its elegant

attenuated form, and its bright yellow colouring. The usual impurities are seeds of Yorkshire fog, sheep's fescue, and blue moor-grass.

The FESCUES (*Festuca*). These comprise an important group of grasses, several of which are of recognised agricultural value. For



Fig. 382.—Dogstail.  
*Cynosurus cristatus*.

our purpose they may conveniently be divided into the broad-leave fescues and the narrow-leaved fescues.

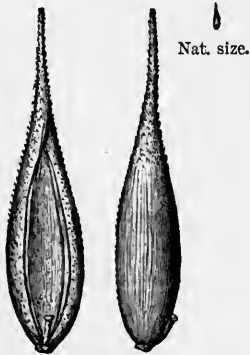


Fig. 383.—“Seed” of  
*Cynosurus cristatus*  
(Crested Dogstail).  
Front and side views,  
magnified 10 diameters.



Fig. 384.—Tall Fescue.  
*Festuca elatior*.

The broad-leaved forms include MEADOW FESCUE (*Festuca pratensis*, Huds.), TALL FESCUE (*Festuca elatior*, L.), and SPIKED FESCUE (*Festuca loliacea*, Huds.). They are all, however, modifications of one type, and that type is best represented by meadow fescue (fig. 387), which is a

grass of moderate size, with flat rich green leaves, and a nodding panicle turned to one side. Tall fescue (fig. 384) is larger and more robust, often attaining a height of six feet, and found naturally on the borders of water-courses. Its "seed" is shown in fig. 385. Spiked fescue is a more slender plant than meadow fescue, and in its panicle (fig. 386) the spikelets are either without stalks, or have only short ones, thus conferring upon the ear some external resemblance to the ear of rye grass, whence the specific name of "loliacea." The "seeds" of meadow fescue and rye grass are so much alike in appearance that it requires some skill and special knowledge to distinguish the one from the other. If, however, the reader will obtain some genuine meadow fescue seed and some true rye grass seed and examine a specimen of each with

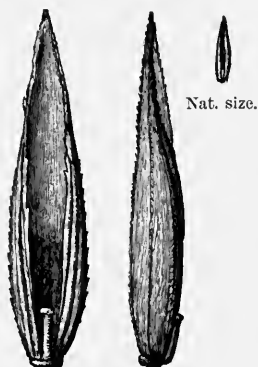


Fig. 385.—"Seed" of *Festuca elatior* (Tall Fescue).

Front and side view,  
magnified 6 diameters.



Fig. 386.—Spiked Fescue.

*Festuca loliacea*.

the aid of a magnifying glass, he will not have much "difficulty" in learning their peculiarities, provided he will regard the following instructions:—Lay the "seed" of meadow fescue (fig. 388) on its back, so that the concave or hollowed-out face is brought into view, and it will be noticed that the basal end of the concavity is occupied by a short length of the flower stalk. Precisely the same thing will be revealed in a similar examination of a "seed" of rye grass. The short length of stalk, however, differs markedly in the two seeds, and it is in these differences that the most readily available distinction between meadow fescue and rye grass is to be found. For, on comparing the two, it is observed that in meadow fescue the fragment of stalk is usually longer, slightly separated lengthwise from the pale, circular in transverse section, somewhat attenuated in the middle and thickened at the free end. In rye grass, on the other hand, the corresponding structure is usually shorter, closely applied to the pale, elliptical in transverse section, and of uniform thickness throughout its length. A little practice will soon enable a careful observer to detect the presence of rye grass in any appreciable quantity in a sample offered as meadow



fescue. Inasmuch as a pound of meadow fescue seed costs from six to ten times as much as a pound of rye grass seed, it is needless to point out the direct pecuniary value of such knowledge.

Meadow fescue (fig. 387) is a valuable constituent both of meadows and of pastures, though recent investigations have shown it to be much rarer in old pastures than was commonly supposed. Owing to its perennial character, it is useful in mixtures of seeds intended to establish permanent pasture. In suitable soils it is almost indifferent alike to winter cold and to late frosts. It is rather a deep-rooting plant, and thrives best on damp clayey or marshy soils; it is an admirable grass for irrigated meadows, but, on the other hand, has not much capacity for withstanding drought. Its habit of growth is in compact tufts, from which, in favourable situations, the stems

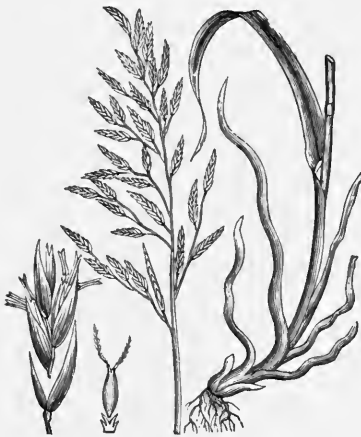


Fig. 387.—Meadow Fescue.  
*Festuca pratensis*.

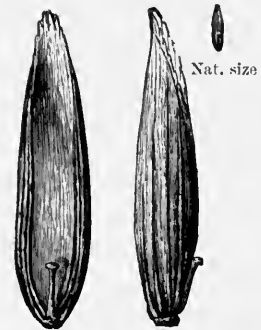


Fig. 388.—“Seed” of  
*Festuca pratensis*  
(Meadow Fescue).  
Front and side views,  
magnified 7 diameters.

rise to a height of from 2 to 3 feet, and are furnished with long broad leaves. But if the soil is dry, thin, and poor in humus, the plant becomes dwarfed and the leaves become short and narrow. It develops less rapidly than certain other familiar species, and does not yield its full produce till the second or third year after sowing; thus, from a given area Vianne obtained only 335 lb. during the first year, and as much as 650 lb. during the second. It re-commences its growth fairly early in spring, but flowers somewhat later than cocksfoot and foxtail. It should, if possible, be cut before it is in full flower, as, after this period, its fibres harden very rapidly. The second cut is less abundant than the first. Unless when cultivated for its seed, meadow fescue is never sown alone. As it does not arrive at its full yield till the second or third year, it is never associated with clovers for one or two years' ley. For irrigated meadows and for permanent pasture it may be employed to the extent of 20 per cent. of the mixture, or even more, but for temporary meadows it rarely constitutes more than 15 per cent.

of the mixture sown. It is claimed for meadow fescue that it will grow where meadow foxtail does not thrive. The Randall Grass of the United States is the same as meadow fescue.

SHEEP'S FESCUE (*Festuca ovina*, L.) may be taken as the type of the narrow-leaved fescues. It forms a thick tufted herbage of very fine leaves (fig. 389), so fine that they are often described as setaceous (Lat. *seta*, a bristle), and in the United States it is known as Pine Bunch

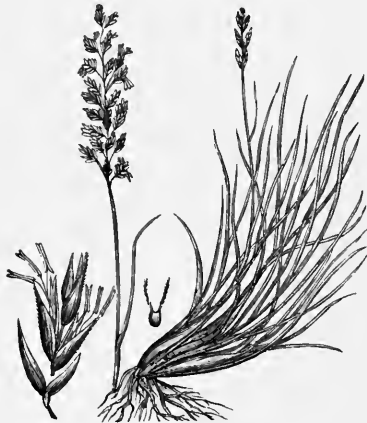


Fig. 389.—Sheep's Fescue.  
*Festuca ovina*.

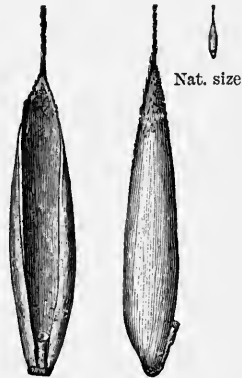


Fig. 390.—"Seed" of  
*Festuca duriuscula*  
(Hard Fescue).  
Front and side views,  
magnified 10 diameters.

Grass. It is a common grass on light limestone pastures and on chalk downs grazed by sheep, and in such situations it helps to form a close carpet of turf. The panicle is not unlike that of some of the meadow grasses (*Poa*), from which it may be distinguished by the presence of short awns, the meadow grasses being free from awns. *Festuca ovina* is susceptible of considerable variations determined by circumstances of soil, situation, and climate. The commonest modifications are

- |                                       |                        |
|---------------------------------------|------------------------|
| <i>Festuca duriuscula</i> . . . . .   | Hard fescue.           |
| <i>Festuca rubra</i> . . . . .        | Red fescue.            |
| <i>Festuca heterophylla</i> . . . . . | Various-leaved fescue. |
| <i>Festuca tenuifolia</i> . . . . .   | Fine-leaved fescue.    |

HARD FESCUE (*Festuca duriuscula*, L.) is so named in allusion to the fact that the spikelets become hard as they ripen. The grass is a valuable constituent of sheep pastures, where it aids in promoting a close bottom to the turf. Its habit, however, is not tufted, and its herbage is tender, juicy, and relished by stock. The leaves are of a deep bluish green colour, stiff, and rolled up almost into a cylinder. Hard fescues may be usefully included in mixtures for permanent pastures upon all soils that are not very wet. Being the commonest of the narrow-leaved fescues its "seed" (fig. 390) is the cheapest.

RED FESCUE (*Festuca rubra*, L.) derives its name from the colour of the sheaths of the lower leaves, which, when the plant is spread open for the purpose, are seen to be of a dull red. A more robust plant than hard fescue, it has at the same time a creeping habit, which helps it to withstand drought, and suits it to poor soils. Like most of the narrow-leaved fescues, this variety does not make sufficient bulk to be of much use in the hayfield, but it is unquestionably serviceable as



Fig. 391.—Red Fescue.  
*Festuca rubra*.

a constituent of the bottom herbage in pastures, where it is readily grazed by stock. Its “seeds” are larger than those of hard fescue. Fig. 391 affords a view of the plant.

VARIOUS-LEAVED FESCUE (*Festuca heterophylla*) is, as its name implies, a grass the leaves of which are not uniform in size and shape. Its foliage varies somewhat between the narrow-leaved and broad-leaved types of fescue, the upper leaves being distinctly broad. The root-leaves are harsh and slender, and enveloped in loose brown sheaths, whilst the general habit of the plant is tufted. It comes into profit fairly early in the season, and thrives best upon calcareous soils, even when they are moist or shady. Its “seed” is represented in fig. 392.

FINE-LEAVED FESCUE, or slender-leaved sheep's fescue (*Festuca tenuifolia*), is a typical constituent of sheep pastures. Its folded, thread-like leaves are so attenuated that the entire plant presents a

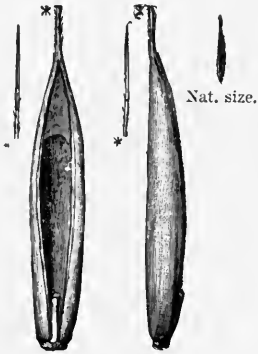


Fig. 392.—“Seed” of *Festuca heterophylla* (Various-leaved Fescue).  
Front and side views,  
magnified 6 diameters.

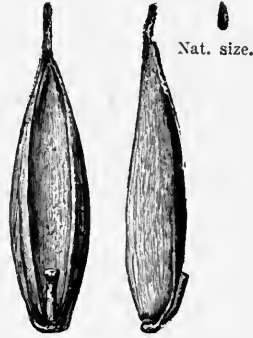


Fig. 393.—“Seed” of *Festuca ovina tenuifolia* (Fine-leaved Sheep's Fescue).  
Front and side views,  
magnified 15 diameters.

wiry appearance. Nevertheless, it is juicy and palatable, and there is no grass more relished by sheep. It is deep-rooted, and is naturally



Fig. 394.—“Seed” of *Agrostis alba*—var. *stolonifera* (Florin, or Creeping Bent Grass).  
With and without the chaff,  
magnified 15 diameters.



Fig. 395.—Marsh Bent.  
*Agrostis alba*.

suitable to poor, dry uplands. It is useless to sow it on rich soils, as it gradually disappears. Fig. 393 affords a view of the “seed.”

FLORIN, or creeping bent grass (*Agrostis alba*, L., var. *stolonifera*), is a stout broad-leaved grass, sending out prostrate stems or stolons,

which creep amongst the other herbage and develop rootlets wherever an opportunity offers. Hence, under favourable circumstances, the plant increases with considerable rapidity. Its panicle of innumerable small spikelets is characterised by the well-defined intervals between the points from which the clusters of branches arise. Fiorin thrives in moist poor soils, both sandy and peaty. It can hardly be described as a favourite food with cattle, but it is useful in that it affords a green bite far into the autumn. It cannot be recommended as a hayfield grass. The "seed" of fiorin (fig. 394) is very liable to contain the seeds of other species of *Agrostis* which are practically indistinguishable from it.

The MARSH BENT (*Agrostis alba*, L.) and the COMMON BENT



Fig. 396.—Common Bent.  
*Agrostis vulgaris*.



Fig. 397.—Floret  
of *Agrostis vulgaris*.

(*Agrostis vulgaris*, L.) are two weed grasses, often included in the common term, twitch, or squitch. They occur abundantly in poor meadows, and as weeds of some descriptions of arable land. See figs. 395, 396, and 397.

In the United States, *Agrostis vulgaris* is variously termed Fine-top, Fine Bent, Tall Red-top, and Summer Dew Grass. Similarly, *Agrostis alba* is known as English Bent, White Bent, Bonnet Grass, White-top and Dew Grass.

MEADOW FOXTAIL (*Alopecurus pratensis*, L.) is one of our early grasses, and may often be found in ear by the middle of April. The ear has much the appearance of a round tail ending in a point (figs. 398 and 399), and if drawn from base to tip between finger and thumb it feels soft and silky. By doubling the ear upon itself, at about the middle of its length it will be seen that each spikelet has a very short stalk, and that the spikelets are thickly crowded along the

axis. The silvery grey colour of the ear is largely due to the silky hair or bristle (the awn), which springs from the solitary flower within each spikelet. The leaves are soft, green, succulent, and very numerous; they are long, broad, and strongly veined. Foxtail throws up much herbage in the early spring, and thus affords valuable grazing at a period before many of the other grasses are ready. Though a tall fine grass it is less robust than cocksfoot; at the same time it is less unsightly.

A perennial grass, of early growth, and affording abundance of



Fig. 398.—Meadow Foxtail.

*Alopecurus pratensis.*

excellent forage, this is one of the most useful species for permanent pasture. Scarcely any grass resists better the cold of winter, and even late frosts affect it but slightly. It appears to thrive equally well in sunny and in shaded situations, and therefore grows luxuriantly in orchards, where indeed its precocious growth may become well advanced before leaves appear upon the fruit trees to intercept the sun's rays. On thin, light soils it gradually disappears, whilst it flourishes best on deep heavy lands. On damp soils and on irrigated meadows it does equally well, but stagnant water is inimical to it.

Meadow foxtail spreads itself by means of short prostrate stolons given off in all directions from the base of its stem. These stolons develop rootlets at intervals, and consequently this grass is quite free

from that tufted habit which prevents such grasses as cocksfoot from forming an even sward. Meadow foxtail shares with sweet vernal the distinction of being the earliest-flowering of all our useful grasses. On a good soil it is quite capable of yielding three cuts in the year. In the year of sowing, however, the yield is only moderate; it is better in the second year, and acquires its greatest development in the third year. As a forage crop, therefore, foxtail is never grown by itself. Associated, however, with meadow fescue, cocksfoot, rye-grass, and alsike clover, it is well adapted for several years' ley, and for permanent pasture.

The "seed" of meadow foxtail, as it occurs in commerce, consists (fig. 400) of the spikelet with its contained floret. It is frequently



Fig. 399.—Meadow Foxtail.  
*Alopecurus pratensis*.



Fig. 400.—"Seed" of  
*Alopecurus pratensis*  
(Meadow Foxtail).  
Magnified 10 diameters.

gathered unripe, and this accounts for the low germinating percentage which samples often give.

Common impurities of foxtail "seed" are the seeds of Yorkshire fog (*Holcus lanatus*), and of creeping soft grass (*Holcus mollis*). Though possessing a close apparent resemblance to the seed of foxtail, they may yet be easily distinguished from it, both by the character and distribution of the fine hairs or cilia upon the glumes which enclose the grain, and by the nature of the awn. Sometimes it happens that meadow foxtail seed is adulterated with the seed of its near ally, *Alopecurus agrestis*, L., variously termed slender foxtail, black bent, or hunger weed, and well known as one of the most objectionable weeds of arable land. The "seed" of this latter, however, is less ciliated upon the keel of the glume, and is usually darker in appearance than that of meadow foxtail. We would strongly recommend farmers to gather, in the course of the summer, seeds of Yorkshire fog and black bent, and to keep them labelled in small bottles for reference. To gather the "seeds" of these two familiar weed grasses it is only necessary to draw the ripe panicles between the finger and the

thumb. One other adulterant, only found, however, in foreign foxtail seed, is the seed of the exotic ciliated melic grass (*Melica ciliata*, L.), but this is easily recognised by the extraordinary extent to which its glumes are fringed with delicate white hairs (cilia).

**FLOATING FOXTAIL** (*Alopecurus geniculatus*, L.) is an elegant little grass (fig. 401) found almost exclusively in water meadows, and around the edges of ponds. Its stem is too weak to grow upright, and it therefore rests upon the ground, or upon the adjacent herbage, being easily recognizable by the sharp joints or "knees," which give to it a zigzag appearance. When in full flower the pollen covers its neat and

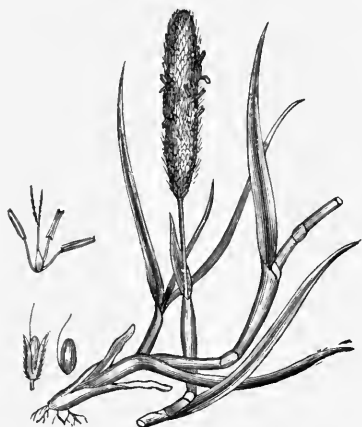


Fig. 401.—Floating Foxtail.  
*Alopecurus geniculatus*.



Fig. 402.—Slender Foxtail.  
*Alopecurus agrestis*.

shapely ear with an orange brown dust. Floating foxtail is never very abundant, and though not an objectionable grass in the moist localities which it frequents, it cannot be said to possess any special agricultural value, nor is its seed to be obtained upon the market.

**SLENDER FOXTAIL** (*Alopecurus agrestis*, L.), is one of the worst pests of the farm. It is a troublesome weed of arable land, especially on corn fields, but rarely invades the meadow or pasture. It possesses (fig. 402) the general habit of the valuable meadow foxtail, but is less robust, and its ear, besides being more slender, is blotched with black,—hence the name of Black Bent commonly applied to it. Another familiar name, and one indicative of its bad character, is that of Hungerweed. It may be found in ear in May and June, and, if not removed before shedding its seed, further trouble may be looked for in the following season. Cases are recorded in which fields of wheat have been quite destroyed by this pest. A caution has already been given as to the occurrence of its seed in samples of meadow foxtail seed.

**MEADOW GRASSES** (Poa).—These grasses are characterised by the



graceful tree-like branching of the panicle. In general appearance they are somewhat suggestive of the fescues, but they never bear awns as many of the fescues do. The most widely distributed member of the group, the ANNUAL MEADOW GRASS (*Poa annua*, L.), is a weed, springing up wherever opportunity may offer. It invades bare spots in pastures, occurs in gateways and on gravel walks, grows in the crevices between paving stones, and flourishes on walls and roofs. An examination of a specimen of annual meadow grass (fig. 403) will bring into view the leading characters of the genus *Poa*. Near the ground the stems are flattened, the leaves are short with blunt ends, whilst the



Fig. 403.—Annual Meadow Grass.  
*Poa annua*.



Fig. 404.—Smooth Stalked Meadow Grass.  
*Poa pratensis*.

ligule is long, pointed, whitish, and clasps the stem. The whole plant is limp and pale-coloured, and the leaves are often waved. Its small size and the brief duration of its life serve to render *Poa annua* practically valueless to the farmer. In the United States it is known by such names as Spear Grass, Dwarf Meadow Grass, May Grass, Suffolk Grass, and Goose Grass.

The following species of *Poa* possess agricultural interest :—

<i>Poa pratensis</i> , L. . . . .	Smooth-stalked meadow grass.
<i>Poa trivialis</i> , L. . . . .	Rough-stalked meadow grass.
<i>Poa nemoralis</i> , L. . . . .	Wood meadow grass.

Notwithstanding their general similarity, it is not difficult to distinguish between these three species. For example, the ligule is long and pointed in *Poa trivialis*, obtuse but prominent in *Poa pratensis*, and practically absent in *Poa nemoralis*. The leaves of *Poa pratensis* are broader and blunter than those of *Poa trivialis*. If the plant is drawn through the hand, *Poa pratensis* is found to be smooth, whilst *Poa trivialis* is rough.

SMOOTH-STALKED MEADOW GRASS (*Poa pratensis*), thrives naturally

upon dry soils of good quality. It (fig. 404) is rather a surface-rooted than a deep-rooted plant, is of creeping habit, and withstands drought. Being a grass of early growth it is, on that account, a valuable constituent of dry pastures. When raised from "seed" (see fig. 407) its produce during the first year is but small. This is the Kentucky Blue Grass, or Pine Grass, of the United States, where it is also known by the names of Green Grass, Spear Grass, English Grass, and Brow-top Grass.

ROUGH-STALKED MEADOW GRASS (*Poa trivialis*), formerly called Orcheston Grass (fig. 405), prefers strong moist soils, and is a conspicuous ingredient of the herbage of deep rich pastures. It is,



Fig. 405.—Rough Stalked Meadow Grass.  
*Poa trivialis*.



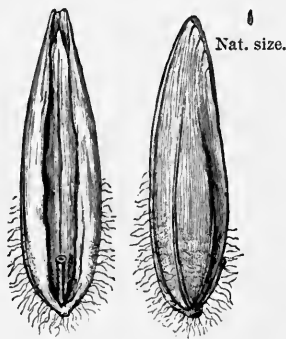
Fig. 406.—Wood Meadow Grass.  
*Poa nemoralis*.

perhaps, less hardy than *Poa pratensis*, and it is particularly addicted to shady situations, so that in pastures and meadows where it occurs it may generally be found in abundance beneath trees. Fine robust specimens occasionally spring up in the rich soil of kitchen gardens, especially amongst bush-fruit. Its "seed" is shown in fig. 408.

WOOD MEADOW GRASS (fig. 406), or evergreen meadow grass (*Poa nemoralis*), is less common than the two preceding species, whilst the costliness of pure samples of the "seed" (see fig. 409) operates against its extensive use for farming purposes.

There is considerable similarity amongst the "seeds" of these three Poas,—see figs. 407, 408, 409. They are all "webbed" at the base,—those of *Poa pratensis* most, and those of *Poa nemoralis* least. In the case of *Poa pratensis*, indeed, the woolly "webs" cause the seeds to adhere together in fluffy masses. In commercial samples, however, the web is often absent, having been removed by the webbing machine. Amongst the impurities or adulterants in samples of *Poa*

seeds are the seeds of annual meadow grass, of tufted hair grass (*Aira cæspitosa*, L.), and of blue moor grass (*Molinia cærulea*, Moench.). What the buyer has chiefly to guard against, however, is the risk of accepting the "seed" of one species of *Poa* for that of another and more expensive kind.



**Fig. 407.**—"Seed" of *Poa pratensis* (Smooth-stalked Meadow Grass).  
Front and side views, magnified 15 diameters.



**Fig. 408.**—"Seed" of *Poa trivialis* (Rough-stalked Meadow Grass).  
Front and side views, magnified 15 diameters.

**OAT GRASSES (*Avena*).**—These belong to the same genus as the cereal oats, which some of the native species closely resemble in habit, though they are usually inferior in size. The most important species are :—

- |                              |                          |
|------------------------------|--------------------------|
| <i>Avena flavescens</i> , L. | Yellow oat grass.        |
| <i>Avena elatior</i> , L.    | Tall oat grass.          |
| <i>Avena pubescens</i> , L.  | Downy oat grass.         |
| <i>Avena pratensis</i> , L.  | Narrow-leaved oat grass. |
| <i>Avena fatua</i> , L.      | Wild oat grass.          |

Of these, the first two are of agricultural value, the remaining three are weeds.

**YELLOW OAT GRASS**, or golden oat grass (*Avena flavescens*), is one of the most elegant of our native grasses (figs. 410, 411). Its leaves are slender, flat, pale green, and covered with short hairs, which can easily be seen by holding a specimen up to the light. The stem is clothed with delicate hairs pointing downwards, which help in distinguishing the grass before it protrudes its ear. The panicle is of a shining yellow colour, and glitters in the sun. Up to the time of flowering the ear is very compact, and is beautifully shaded with green and gold, whilst the delicate silky awns look like streaks of silver. As the flowers develop, the entire panicle spreads out into a tree-like form, and it is at this stage that *Avena flavescens* forms one of the most elegant Midsummer objects in our meadows. When the blooming time is over, and the seeds begin to ripen, the panicle closes up again, its lovely colours disappear, and it becomes brown

and withered. If panicles in the three stages—before flowering, in bloom, and after flowering—are placed side by side, it is at first



Fig. 409.—“Seed” of *Poa nemoralis sempervirens* (Evergreen Meadow Grass). Front and side views, magnified 12 diameters.

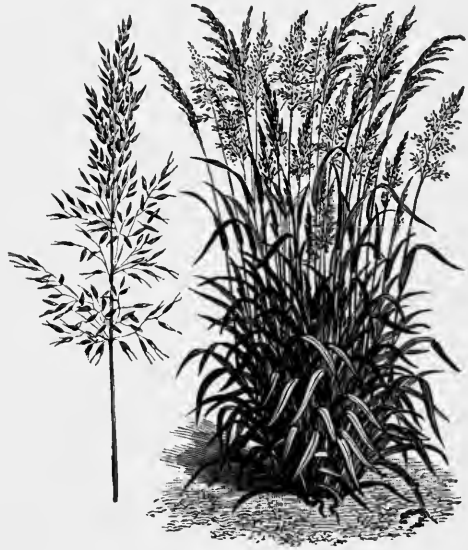


Fig. 410.—Yellow Oat Grass. *Avena flavescens*.

difficult to believe that they belong to the same plant. *Avena flavescens* is a valuable grass both for forage and for hay. It



Fig. 411.—Yellow Oat Grass. *Avena flavescens*.

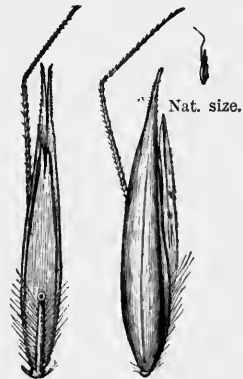


Fig. 412.—“Seed” of *Avena flavescens* (Yellow Oat Grass). Front and side views, magnified 8 diameters.

occurs naturally in pastures, hayfields, and water-meadows, in all of which it is a desirable constituent. Its “seed” (fig. 412) is costly, and

that of the wavy hair grass (*Aira flexuosa*, L.), which somewhat resembles it, has been known to be fraudulently substituted for it. This hair grass is a product of poor heaths and sands, and is incapable of establishing itself in good meadows or pastures.

TALL OAT GRASS, or false oat grass (*Avena elatior*, L., or *Arrhenatherum avenaceum*, Beauv.), may frequently be found in or near the hedgerows bordering grass-lands. Though often regarded as a weed, yet, in its proper place, and in association with other grasses, there is little doubt it possesses agricultural value. Foreign agriculturists appreciate it more than do British farmers. It thrives best on



Fig. 413.—Tall Oat Grass.  
*Avena elatior*.



Fig. 414.—Downy Oat Grass.  
*Avena pubescens*.

medium soils and clay loams, where, being a robust plant, it attains a height of three or four feet. It can be found in ear from early summer to late autumn, its spreading panicle (fig. 413) being made up of pale or purplish spikelets, always of a shining appearance. The bitter flavour of the plant is hardly noticeable when it is consumed in conjunction with other grasses. On arable soils there occurs a weed variety, characterised by the formation of a bulb-like growth in the ground, just above the root,—to this form the name of “Onion couch” is given. *Avena elatior* is known in the United States by such names as Evergreen Grass, French Ryegrass, Grass of the Andes.

Of the weed oat grasses, *Avena pubescens* is characterised (fig. 414) by the dense covering of close-set hairs, which impart to the plant a downy appearance. It may be found in dry pastures, especially in chalk districts. It is readily distinguished from the valuable yellow oat grass, thus :—

	Spikelets.	Ligule.
Downy oat grass, <i>Avena pubescens</i> . . .	Few, large . . .	Long, pointed.
Yellow oat grass, <i>Avena flavescens</i> . . .	Many, small . . .	Short, blunt.

The narrow-leaved oat grass, *Avena pratensis*, L., has still larger spikelets than *Avena pubescens*, but its lower leaves, though harsh and rough, are not hairy. The wild oat grass, or havers, *Avena fatua*, L., is a weed of cornfields, and much resembles the cultivated



Fig. 415.—Wild Oat Grass.  
*Avena fatua*.



Fig. 416.—Perennial Rye Grass.  
*Lolium perenne*.

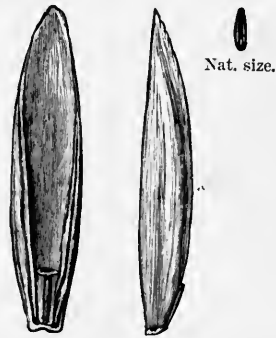


Fig. 417.—“Seed” of *Lolium perenne* (Perennial Rye Grass).  
Front and side views, magnified 8 diameters.

oat. Its spikelets are large (fig. 415), and the contained florets are each furnished with a long twisted awn, and with a number of reddish-brown hairs, pointing forward at the base. The stem is smooth, but hairy at the joints. This plant is an annual, growing from seed each year, and dying on the approach of winter.

The RYE GRASSES (*Lolium*) are very extensively cultivated. Perennial rye-grass (*Lolium perenne*, L.) is the most abundant species of grass in rich old English pastures, and in laying land down to permanent grass it should always be included, the proportions varying according to circumstances. Italian rye-grass (*Lolium Italicum*, A.Br.) is not a grass of permanent pasture, but is profitably included in mixtures for one or two years' leys, and thrives remarkably well upon sewage-dressed lands.

PERENNIAL RYE GRASS (*Lolium perenne*, L.) can scarcely be mistaken for any other species. The flattened ear (fig. 416) looks almost as if it had been passed through a press. The spikelets, free from stalks, are given off alternately on either side of the stem, to which they are attached edgewise. Each spikelet has only one empty glume, the place of the other being, in effect, occupied by the adjacent portion of the stem or axis. The glossy dark green leaves of rye-grass glisten conspicuously in the sunlight. A prominent mid-rib extends along the back of each leaf, and as the leaf is traced downwards into its sheath it is found to be doubled on itself like the contiguous faces of a sheet of note-paper. Moreover, the leaf-sheaths are seen to be distinctly flattened or compressed, and frequently to possess a reddish or purplish tinge. By the foregoing characters rye-grass, before it is in ear, can easily be distinguished from meadow fescue grass, the leaf of which has no prominent mid-rib, and is not doubled upon itself, nor are the leaf-sheaths compressed, but round. The flattened leaf-sheaths of rye-grass enable it to accommodate itself readily to the treading of live stock, and even to thrive under the hoofs of animals, and this may be one reason for the great abundance of perennial rye-grass in well-grazed pastures. Rye-grass is likely to be found wherever the soil is rich enough to grow it. Hence, it commonly grows amongst the herbage of road sides, where the soil is enriched with the washings and the scrapings from the surface of the road.

Sometimes extolled, at other times depreciated beyond measure, rye-grass is nevertheless one of the most valuable plants of our grass lands. It is not of tall growth, and is rather an "under grass," or bottom grass, than an "over grass, or top grass," to adopt the German phraseology. In clay-land pastures it is invaluable, and its seed is included in large proportion in mixtures intended for the establishment of rich pastures upon the alluvial flats of North Germany, where, indeed, experienced cultivators often sow, with this object, nothing but rye-grass and a little white clover. The duration of rye-grass varies a good deal, says Stebler, according to soil and climate; in light soils and under a dry sky it remains only a couple of years, whilst in a good stiff soil and a moist climate it persists seven years or more. It is under the latter conditions that it thrives in Britain.

Rye-grass tillers, or stools out, very freely, and forms a thick close sward. It easily supports frequent grazing or pulling by hand. Trampling or treading does it no harm, but rather enhances its useful propensity to tiller; this is the reason it gives better results as a

pasture plant than as a meadow plant. The yield varies considerably with season and soil, and according to the manuring and preparation of the land.

As regards its hardiness rye-grass suffers sometimes in cold situations in winter, without, however, succumbing. The humidity of maritime climates like those of England, and of the countries bordering the German Ocean, suits it best, especially when growing on good clays. Cool, compact soils suit it well, and even very heavy soils, if well drained.

Though many varieties of rye-grass have been named—such as Pacey's perennial, Devon eaver, &c.—they present no well-marked or permanent differences.

To the grazier no grass exceeds rye-grass in importance; probably, indeed, no other grass equals it. No hay fetches so high a price as that in which rye-grass is the leading constituent. No pastures afford richer grazing than those in which rye-grass has been proved to predominate. As to its duration, Mr. David Wilson, writing in the "Farming World Year Book, 1891," says, "That it is sufficiently permanent is proved by the examination of old pastures made by Messrs. Fream & Carruthers,<sup>1</sup> which show that no other grass is so abundant in the most feeding old pastures all over the United Kingdom."

One of the strangest arguments ever brought against a farm plant was directed against rye-grass when it was urged by the opponents of this species that it is "greedy of manure" and "robs the soil." It would hardly be possible to adduce any more potent facts *in its favour*. In applying fertilisers to land the object really is to feed the crop and not to manure the soil. A crop that readily abstracts from the soil the fertilisers that are therein available is precisely the crop to encourage. What fertility the crop does not utilise is lost. Rye-grass prevents this loss.

Though pre-eminently a grass of permanent pasture, rye-grass is also largely employed in mixtures of "seeds" for one or two years' ley, intended to afford a hay crop, and also to provide temporary pasturage. If only on account of its prompt and luxuriant tillering, rye-grass ought never to be omitted from any mixture intended for a good soil.

The "seed" of commerce (fig. 417) comes chiefly from Scotland and the North of Ireland, where rye-grass is cultivated upon a large scale. It is collected by the seed merchants, cleaned a second time, and assorted into various qualities. Special care is taken to clean it of seeds of Yorkshire fog (*Holcus lanatus*), soft brome (*Bromus mollis*), and rat's-tail fescue (*Festuca sciuroides*). The rye-grass seed itself is classified into several commercial sorts, according to weight, purity, and germinating capacity. As the better qualities possess, in general,

<sup>1</sup> Readers interested in the controversial side of the subject are referred to a paper on "The Herbage of Old Grass Lands," by W. Fream, in the "Journal of the Royal Agricultural Society of England," 1888, and to another on "The Facts about Rye grass as determined by Experiment," by the same author, in the "Transactions of the Surveyors' Institution," 1889-90. Also to papers by Carruthers and Fream respectively, in the "Journal of the Royal Agricultural Society," 1890.



a greater weight, it is the weight which serves in England as a guide to the value of the seed. Rye-grass seed is also liable to contain seeds of plantain, buttercup, and sorrel. On account of its low price, it runs but little risk of adulteration. Nevertheless, the seed of soft brome is sometimes sold in bulk as that of rye-grass, but the fraud is one which is easy to discover. It used more often to happen that rye-grass seed was itself substituted for an apparently similar but more expensive seed, that of meadow fescue, for the sake of the extra profit.

Some confusion has arisen in England through accepting American opinions upon "rye-grass" and applying them to our *Lolium perenne*.



Fig. 418.—A Spikelet of Italian Rye Grass.

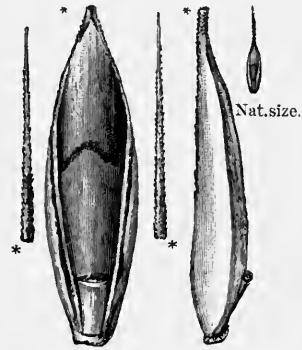


Fig. 419.—"Seed" of *Lolium italicum* (Italian Rye Grass).  
Front and side views,  
magnified 7 diameters.

As a matter of fact, the term "rye-grass" is, in the United States, applied not only to *Lolium*, but to four or five species of the genus *Elymus*, which differs in various essential characters from *Lolium*.

ITALIAN RYE GRASS (*Lolium italicum*) is a larger and more robust plant than perennial rye grass, and its florets (fig. 418) are invariably awned, as may also be seen in the "seed" (fig. 419), whilst those of perennial rye-grass very rarely carry awns. It is exclusively used for alternate husbandry, for which purpose it scarcely has an equal. On rich damp soils, and on almost any soils that can be irrigated with liquid manure, Italian rye-grass yields enormous crops, equally valuable both for soiling purposes and for hay. It may be grown alone, or in association with cocksfoot, timothy, or broad clover. Dairy cows, grazed upon a temporary ley of Italian rye-grass, give a great yield of milk, the flavour of the butter or cheese from which is excellent. This species is never found in old pastures.

DARNEL (*Lolium temulentum*, L.), is an occasional weed of corn-fields. It is distinguished from the other rye grasses by the circum-

stance that the solitary outer glume is longer than the spikelet to which it belongs (see fig. 435, page 927). Poisonous or intoxicating properties have been attributed to it.

SWEET GRASSES (*Glyceria*) occur naturally in water meadows and in the Fen districts, and are seldom raised from seed. In the grass lands which they frequent, they constitute acceptable and palatable additions to the herbage, and are, as their name implies, distinctly sweet. The floating sweet grass, or floating manna grass (*Glyceria fluitans*, Br.), is a slender and graceful grass, sometimes liable to be mistaken for the spiked fescue (*Festuca loliacea*), which grows in association with it. The spikelets of the sweet grass are, however, longer, and contain a larger number of florets than is the case in spiked fescue. The reed sweet grass (*Glyceria aquatica*, Sm.) is a far stouter plant, and shows a disposition to grow in the water courses and along their borders rather than to spread itself over the meadow; it is the White Spear Grass of the United States.

SWEET-SCENTED VERNAL GRASS (*Anthoxanthum odoratum*, L.) is



Fig. 420.—Sweet Vernal Grass.  
*Anthoxanthum odoratum*.



Fig. 421.—“Seed” of *Anthoxanthum odoratum*  
(Sweet-scented Vernal Grass).  
With and without the chaff,  
magnified 12 diameters.

one of the earliest grasses to come into flower, and it may often be gathered in ear at the beginning of April. Its florets (fig. 420) are characterised by possessing only two stamens, instead of the normal three. It is a plant of sparse habit, and though it may be found in water meadows, hay-fields, pastures, copses, and hedgerows, it never constitutes more than an insignificant proportion of the total herbage. If the stalk of this grass be chewed, a sweet lavender-like odour, similar to that of new mown hay is perceived. This odour is given out in the process of drying, and to it the agreeable scent of a freshly mown hay-field is attributed. On the sheep-grazed Downs of the South of

England sweet vernal grows in association with sheep's fescue. The leaves of sweet vernal are flat, broad, and somewhat hairy, but the grass is not of coarse growth. The function of sweet vernal, both in pastures and in hay, is probably that of a condiment, as it is capable of imparting a flavour to the associated herbage. It grows in compact tufts, tillers freely, and continues to throw up its leaves until late in the autumn. The awns are hygroscopic, so that if some of the "seeds" (fig. 421) are placed upon the warm moist palm of the hand they will commence to writhe and wriggle about in a curious fashion.

Most of the seed of commerce comes from Central Germany, being derived not from plants specially cultivated for the purpose, but gathered in glades and copses. The seed is therefore obtained only by long and fatiguing labour, and genuine samples are necessarily of high price. Derived from such sources, however, the seed is seldom pure, being usually mixed with seeds of other plants growing in the same localities, notably the seeds of woodrush, sheep's sorrel, and sheep's fescue. In the district north of Luneburg, Prussia, there is frequently found growing in rye crops a bad annual weed, allied to sweet vernal, and known as Puel's vernal grass, *Anthoxanthum Puelii*. This forms such dense tufts that the scythe can scarcely cut them, and hence the mowing of the rye is rendered difficult. One district of the region named sends annually to Hamburg about 40,000 lb. of the seed of Puel's vernal grass, and this worthless material finds its way into commerce as the seed of the true sweet vernal. On account of this origin the seed of Puel's grass often contains the long pointed grains of rye, as well as the seeds of the wind grass (*Apera Spica-venti*), of corn bluebottle, and of the annual knawel. It is not altogether easy to determine whether a solitary "seed" is that of *Anthoxanthum odoratum* or of *A. Puelii*, but viewed in the bulk the latter is of a distinctly lighter brown colour than the former, whilst the "seeds" of the latter are somewhat shorter. Puel's grass is of little value. During its first year it permits scarcely any of the grasses near it to develop, whilst its dense tufts help to smother them. If, however, it is not allowed to shed its seed, it usually disappears in the second year. The seed of sweet vernal is sometimes adulterated with that of wavy hair-grass (*Aira flexuosa*), but this is readily recognised by the lower half of its prominent basal awn being twisted.

TIMOTHY GRASS (*Phleum pratense*, L.) also called meadow catstail, derives its more familiar name from Timothy Hanson, by whom the cultivation of this grass was introduced from the United States of America into Britain about the middle of the eighteenth century. In the United States it is also called Herd's Grass, Catstail, and Tame Timothy. It is a native British species, and is relished by all classes of farm stock.

The only grass that timothy might be mistaken for is meadow foxtail, there being a general resemblance between the ears of these two species. A brief examination will serve to show, however, that they are really very different. The ear of timothy (figs. 422, 423) is

green and rough, whereas that of foxtail is silvery grey and smooth; the florets of foxtail carry silky awns, those of timothy are awnless. Foxtail is an early grass, timothy a late one; the former will have gone to seed almost before the latter appears in ear, as timothy does not flower till July. The leaves have a greyish-green colour, and they are broader and—especially when dried—stiffer or more rigid than those of foxtail,

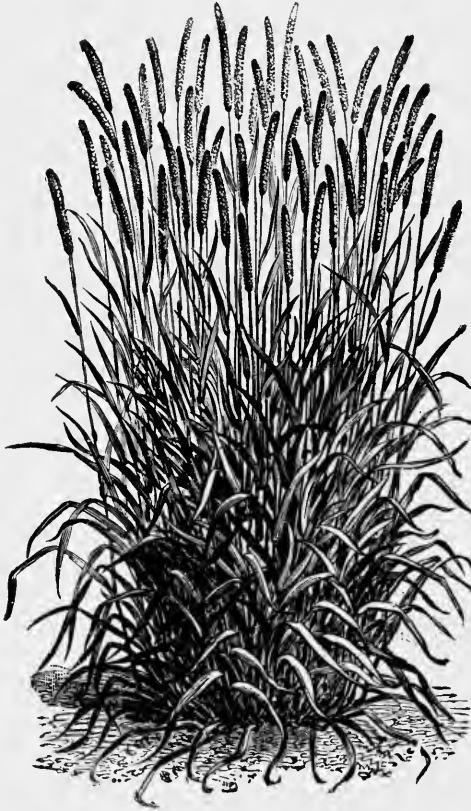


Fig. 422.—Timothy Grass (*Phleum pratense*).

hence no difficulty is experienced in picking out the leaves of timothy from a sample of hay. Timothy is a perennial grass, with well developed fibrous roots. Sometimes the base of the stem, immediately above the root fibres, becomes bulbous.

Although timothy prefers a cool and even damp soil, it yet resists drought very well, but yields in this case less produce. At the same time it suffers less from the cold of winter than do several other cultivated grasses, and hence it is useful upon soils where other forage plants are liable to be killed by the winter's frosts. It succeeds best upon cold clays, and is specially valuable for reclaimed peaty soils.

On dry soils and upon shallow calcareous lands it yields a very uncertain produce. Experiments prove that timothy responds freely to liberal manuring, and even a poor, light, sandy soil when dressed with sulphate of potash gave a much increased yield of timothy.

Grown by itself, timothy produces a somewhat irregular sward of moderately close tufts. Associated with other grasses or with clovers, it gives an abundant produce, for its hay is heavier than that of any other cultivated grass. It should be mown before flowering, otherwise its fibres become woody and its hay heavier and harder. The first cut is usually more productive than the second.

Whether grown alone, or mixed with clover, timothy is more useful



Fig. 423.—Timothy Grass (*Phleum pratense*).



Fig. 424.—"Seed" of *Phleum pratense* (Timothy, or Meadow Catstail).

With and without the chaff, magnified 15 diameters.

as green forage than as hay, because, even if the crop has been cut at the most desirable time, this species always hardens in drying.

The chief supplies of timothy "seed" (fig. 424) are derived from North America, and in part from Eastern Germany and Austria. The American seed is usually much purer than the European, a circumstance no doubt due to the extensive cultivation of timothy as a crop by itself in North America. In the Eastern Provinces of Canada, and in the United States, we have seen large fields of pure timothy which would astonish British farmers, and the example of which they would be ill-advised to follow. The raw European seed commonly contains from 10 to 20 per cent. of impurities, consisting of harmless particles of soil and vegetable fragments, and of the seeds of bad weeds. In timothy seed received at the Swiss seed control station at Zurich, from Breslau, the weed seeds usually comprise field chamomile (*Anthemis arvensis*), bladder campion (*Silene inflata*), mouse ear chickweed (*Cerastium triviale*), spurrey (*Spergula arvensis*), small scorpion grass (*Myosotis intermedia*), rib grass or plantain (*Plantago lanceolata*), sorrel (*Rumex Acetosella*), self heal (*Prunella vulgaris*), sandwort

(*Arenaria serpyllifolia*), ox-eye daisy (*Chrysanthemum Leucanthemum*), and even clover dodder (*Cuscuta Trifolii*). The last-named is found in samples which have been obtained from timothy grown in association with clover, the latter being attacked by dodder. In the process of sifting, the fine dodder seeds easily pass through with those of timothy, and though dodder never attacks timothy or any other grass, yet when dodder-infested timothy seed is sown with clover seed the clover plant is likely to become attacked. American samples of timothy seed are probably always free from dodder. The cheapness of timothy seed renders it scarcely worth while to resort to adulteration, but particles of grey sand have been used for this purpose. These sandy particles, possessing the same colour as the seed, are liable to be overlooked in a superficial examination, though easily detected with a little care, and promptly discovered in testing the germinating capacity of the sample.

This seems an appropriate stage at which to speak of certain weed grasses, or "vagrants," which it has not been found convenient to describe in the preceding section. The undesirable grasses now to be dealt with comprise the Brome Grasses, Couch Grass, Hair Grasses, Meadow Barley Grass, Quaking Grass, and Yorkshire Fog. They cannot be said to be wittingly cultivated by the farmer, but they frequently intrude, as uninvited guests, upon his domain.

The BROME GRASSES (*Bromus*).—The native species of *Bromus* are



Fig. 425.—Soft Brome Grass.  
*Bromus mollis*.



Fig. 426.—Smooth Brome Grass.  
*Bromus racemosus*.

all weeds. They are handsome grasses, with elegant lance-shaped spikelets, each containing five or more awned florets. By far the most common is the soft brome grass (*Bromus mollis*, I. fig. 425), a too abundant constituent of the herbage of water-meadows, hay-fields,

and temporary leys, though but rarely found in old pastures. It sheds its seed in June, and is thereby enabled to maintain its position in the hayfield. Its spikelets are covered with short hair, which serves to distinguish it from the smooth brome grass (*Bromus racemosus*, L. fig. 426) that frequently grows beside it. Barren brome grass (*Bromus sterilis*, L., fig. 427) is chiefly a roadside grass, and lurks beneath fences and hedgerows; its spikelets are darkish, flattened, and long-awned. Hairy brome grass (*Bromus asper*, Murr., fig. 428), another denizen of the hedgerows, is the tallest of the bromes, often towering above the tops of the hedges. It has a large drooping panicle with nodding spikelets, and the stem is densely clothed with coarse hairs pointing downwards. Upright brome grass (*Bromus erectus*, Huds.



Fig. 427.—Barren Brome Grass.  
*Bromus sterilis*.



Fig. 428.—Hairy Brome Grass.  
*Bromus asper*.

fig. 429) is a short-awned grass found in fields, but chiefly in waste places, upon chalky soils. In the United States *Bromus mollis* is known as Soft Chess, and *Bromus racemosus* as Upright Chess.

COUCH GRASS (*Triticum repens*, L.) is characteristically a weed of arable land, and its presence in permanent grass lands need only be looked for during the first year or two of their existence. Its vigorous underground stem grows with great rapidity, and sends forth roots and shoots at such frequent intervals that one plant is capable of speedily infesting a large area. The branching of the underground stem results in a network, forming a bed or couch, in allusion to which the plant probably received its name of couch grass. The labour of cleaning land from couch is chiefly directed to removing these troublesome underground stems,—if they are merely cut up and left in the ground, each fragment will commence to grow as an independent plant. In Italy these stems, which are juicy, sweet, and nourishing, are collected, washed, and sold as food for horses. Couch grass in ear may often be found in the hedgerows of arable fields. The spikelets have no stalks;

they are (like those of wheat) set broadside on the stem, and each is furnished with two outer or empty glumes. By the two last-named characters an ear of couch grass is readily distinguished from an ear of rye grass. Quack Grass, Quick Grass, Quitch Grass, and Wild Wheat-grass, are amongst the names by which *Triticum repens* is known in the United States.

The HAIR GRASSES (*Aira*) make up a pretty group of plants, but



Fig. 429.—Upright Brome Grass.  
*Bromus erectus*.

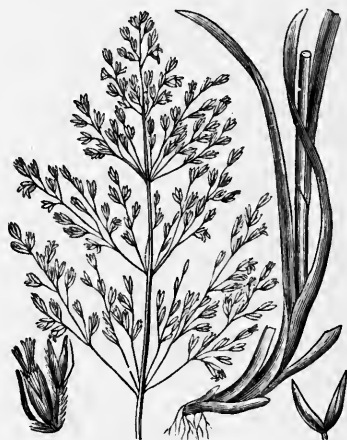


Fig. 430.—Tussock Grass (*Aira caespitosa*).

they are all weeds. There are half-a-dozen native species, though, as a rule, only one is met with upon the farm,—the tufted hair grass, or tussock grass (*Aira caespitosa*, L.). It grows chiefly in wet meadows and pastures, forming dark unsightly tufts or tussocks, termed in some districts “bull faces” or “bull pates.” Cattle seldom touch the hard, rough, flat leaves. Up to the time of flowering the panicle is exceedingly beautiful, owing to the brilliant silvery lustre of the purplish spikelets. At the time of flowering the panicle (fig. 430) spreads wide open, and does not close again, the effective result of its compact appearance when young being thereby lost. Drainage and manuring operate against *Aira caespitosa*, and hand pulling is sometimes resorted to, the root being left to wither on the ground or thrown upon the compost heap. More commonly the hassocks are chopped up with an adze.

MEADOW BARLEY GRASS (*Hordeum pratense*, Huds.), has the appearance (fig. 431) of a diminutive plant of the cereal barley. It is not cultivated, as the long rough awns are unpleasant, and may prove injurious, to grazing animals. It occasionally occurs in hayfields and pastures, but is seldom abundant. The allied wall barley (fig. 432), or way bent (*Hordeum murinum*, L.), is a weed of gravelly roadsides.



QUAKING GRASS (*Briza media*, L.), is too well known to need description. It grows usually on poor meadows and heaths, and

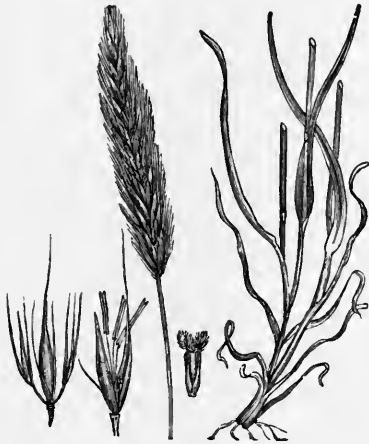


Fig. 431.—Meadow Barley Grass  
(*Hordeum pratense*).



Fig. 432.—Wall Barley Grass  
(*Hordeum murinum*).

throws up but little herbage. It seldom occurs in old pastures, save on light gravelly land, and generally disappears as a result of draining



Fig. 433.—Yorkshire Fog  
(*Holcus lanatus*).



Fig.—434.—Creeping Soft  
Grass  
(*Holcus mollis*).

and liberal manuring. Its panicle, with the beautiful purplish, nodding, boat-shaped pikelets on their slender stalks, is an exceedingly elegant object,—it is easy to see in quaking grass what is meant by a “spikelet.”

YORKSHIRE FOG (*Holcus lanatus*, L.) is a widely distributed weed-grass. The whole plant has a delicate woolly covering (fig. 433), whence it is also known as meadow soft grass, and, in North America, as velvet grass. This external coat, the flaccid character of the plant, and its bitter flavour combine to render it distasteful to stock. Its panicle, which remains closed up to the time of flowering, is a pretty object with its various shades of colour, ranging from greenish to purplish. The panicle spreads out at the time of flowering, and as the seeds ripen it assumes a brown and withered appearance. Yorkshire fog is very common in water meadows, and in inferior hayfields. It is less abundant in rich pastures, from which it is sometimes entirely absent. As it ripens its seeds early, hay containing much Yorkshire fog may be the means of disseminating this pest on arable sheep farms. The hay being fed in troughs to the sheep, the "seeds" of the Yorkshire fog fall out upon the ground, with the result that rows of *Holcus lanatus* spring up in the places where the troughs have stood. Yorkshire fog should be discouraged in favour of better grasses, and care should be exercised lest its seed be inadvertently introduced, either as an adulterant or an impurity, in mixtures for sowing.

The closely allied creeping soft grass (*Holcus mollis*, L.) is much less common. It (fig. 434) frequents hedgerows, copses, and waste places, seldom intruding upon either the meadow or the pasture. Whilst *Holcus lanatus* is equally woolly all over, *Holcus mollis* is more woolly at the joints than on any other portions of the plant; by this means the two species can be distinguished the one from the other.

Various fungoid parasites<sup>1</sup> attack grasses. Rust (*Puccinia graminis*, Pers.) so commonly seen upon the straw of cereals, may also be noticed upon meadow grasses. The white rust, or grass mildew (*Erysiphe graminis*, D.C.) causes an appearance like streaks of white-wash upon the leaves and stems. Smut and bunt appear upon the ear or panicle. Smut (*Ustilago carbo*, Tul.) converts the ear into a dark brown, or chocolate-coloured dust, which is easily blown away by the wind. Bunt (*Tilletia caries*, Tul.) causes the grain in the ear to swell up into a greasy mass, with a disgusting fish-like odour; its attacks appear in England to be confined to wheat and barley. None of the foregoing fungoid pests of grasses are, however, so dangerous as ergot, which, as it is frequently the subject of inquiry on the part of graziers, merits special notice.

ERGOT (*Claviceps purpurea*, Tul.) is easily recognised by the peculiar spur-like protrusions from which the fungus derives its name (French, *ergot*, a spur or cock-spur). These are so characteristic that, when once known, no other fungal pest upon grasses is at all likely to be mistaken for ergot. The spurs or ergots (figs. 435, 436) vary in size according to the species of grass attacked, but their shape and general appearance are always much the same, though the colour, which is at

<sup>1</sup> For fuller details, see "Elements of Agriculture," by W. Fream. London: John Murray, Sixth Edition, 1897.



Fig. 435.—Darnel  
Grass (ergoted).

first of a somewhat ashen or dull leaden hue, becomes at length purplish-black. Examination serves to show that the ergots have usurped the place of the grain, or, in other words, that the structure which under normal circumstances should ripen into the fruit, or grain, or so-called "seed" of the grass, is replaced by the hard, dingy-looking protuberance called ergot. This is the stage in which the parasite is dangerous, and when its consumption by in-calf cows may prove to be one of the causes of abortion, bringing in its train annoyance, disappointment, and loss.

Special attention is directed to the fact that ergot only attacks the ovary, or young grain, of grasses. From this circumstance may be drawn two very obvious but practical conclusions: in the first place, that it is useless to look for any indications of ergot upon the stems or leaves of grasses; in the second place, that the only period during which ergot can be found growing upon a grass is when the latter has expanded its flowering-head or panicle. A grass before flowering is free from ergot.

Since, then, ergot is only to be found in the flowers of grasses, little danger need be apprehended from it during spring and early summer. But from midsummer down to the end of the year precautions are necessary. The earliest date on which we have actually detected ergot has been in the first week of July, but by careful observation it may possibly be discovered earlier. Obviously, it may be expected to appear at different times on different species of grass, according to their time of flowering; thus it may be looked for earlier in sweet vernal or in foxtail than in timothy grass. The later flowering grasses, and those whose "bents" remain



Fig. 436.—  
Timothy Grass  
(ergoted).

standing far into the winter, afford means whereby the presence of ergot may be ensured almost till the return of spring. Excepting in

very sheltered places, however, the boisterous winds of November possess sufficient violence to detach the ripe ergots from the positions they have usurped, so that they fall into stagnant water or upon moist earth, and there remain till the warmth of approaching summer causes them to germinate and to discharge into the air their myriads of microscopic spores, some of which, coming into contact with the expanding florets of grasses, alight upon the ovaries, as a result whereof these latter, instead of ripening into the grain or "seed," develop into new ergots.

Having shown that the presence of ergot may fairly be looked for during about half the year, we pass on to notice the localities in which it may be expected to occur. These are neither the regularly-mown meadow nor the well-grazed pasture. In the former the grasses are cut too early to permit of the development of ergot, whilst in the latter the grasses are seldom allowed to attain the flowering stage which, as has been explained, is an indispensable antecedent to the appearance of ergot. But the boundaries of meadow or pasture are frequently such as to favour in the highest degree the rapid development of ergot. A stagnant ditch overshadowed by a hedge seldom fails to afford ergoted grasses at the proper season. Similarly, a damp, low-lying spot in a grass-field, where the herbage is rank and sour, is a locality which need rarely be searched in vain. Badly-drained grass lands, therefore, are favourable to ergot, and it follows that thorough drainage is a radical remedy for reducing the presence of the pest to a minimum. Roadside ditches constitute a very favourite habitat of ergot, and in such localities we have seen it growing in the greatest profusion. Cattle in passing along roads and lanes bordered by such ditches obtain easy access to large quantities of ergot. Stagnant water and sluggish streams appear to be much more favourable to the growth of ergot than do swift-flowing streams, probably because in the latter the velocity of the current would sweep away any ergots that happened to come under its influence, whereas in the former cases the ergots would remain where they had fallen and germinate in the following season.

The presence of ergot having been detected in a locality to which in-calf cows have ready access, steps should be taken to remove the ergot out of reach of the cows, but, failing this, to keep the cows away from the ergot. As the autumn advances and the close of the grazing season approaches, a special source of danger arises from the circumstance that pastures begin to fail, and cows find an increasing difficulty in obtaining a sufficiency of food. Then it is they begin to graze in spots which they have previously shunned, and to seek for food in the damp herbage amongst which ergot luxuriates. Conditions better calculated to induce abortion can hardly be conceived, and, once commenced amongst a herd of in-calf cows, abortion may extend indefinitely.

A common source of ergot is to be found in grass seeds, and it is highly important that all seeds, whether for one or two years' ley, or for longer duration, should be carefully examined before sowing. If

any trace of ergot is detected, the entire parcel of seeds in which it occurs should, without hesitation, be rejected ;—it would be foolish to retain the parcel at a reduction in price, and it would be unwise to accept it even as a gift. The ergots occurring upon the finer grasses, such as florin, have an appearance much resembling the dung of mice, and, being mistaken for this, they are regarded as harmless. Ergot is less uncommon than might be supposed in corn crops, and in July we have gathered fine specimens of ergoted wheat and barley. A series of abortions came under our notice one winter, in which, after inquiry and examination, we found that the dietary of the cows included barley awns amongst which ergot was fairly abundant, and was, we strongly suspect, the cause of the mischief. Hay, again, is not always to be trusted, particularly if, on account of wet weather, the period of cutting has been unduly delayed. In such circumstances, ergot may not unreasonably be looked for, and such hay should never be served to in-calf cows.

It is unnecessary to discuss here the therapeutic properties of ergot. That it is competent to produce abortion there is not the slightest doubt; it is equally true that in-calf cows sometimes eat ergot with impunity. It is possible that the effects of ergot will depend upon the animal herself, and upon the circumstance whether the stomach is already well-filled or not.

Most of the foregoing remarks were communicated by us to the "Journal of the British Dairy Farmer's Association, 1886," and may be briefly summarised as follows :—

1. Ergot, a parasitic fungus, attacks pasture grasses, weed grasses, and cereals. It never occurs on clovers or other cultivated plants.
2. When eaten by in-calf cows, ergot is believed to be capable of inducing abortion—that is, premature expulsion of the calf.
3. Abortion thus commenced may extend to other cows of the herd.
4. Keep a sharp look-out for ergot in sunk fences, ditches, and other damp situations, from June onwards.
5. Perseveringly gather all ergoted grasses; do not cut them down and leave them on the ground.
6. Carry away all the ergoted specimens and burn them; do not throw them on the rubbish heap.
7. Get in the hay crop before the grasses have had an opportunity to become ergoted.
8. Never sow grass seeds containing ergot.
9. Show your neighbours specimens of ergoted grasses, and invite their co-operation in exterminating the pest.

Of the insect pests of grasses, two may be mentioned as specially troublesome,—wireworm and leather jacket. The yellowish, six-legged wireworms, which are the larvæ of click beetles, live from three to five years before they turn to pupæ. During the whole of this time they are actively engaged in their destructive work amongst the roots. Broken-up pasture land and clover leys often swarm with wireworms.

Close grazing, folding with sheep, dressing with lime, gas-lime, salt, &c., and heavy rolling, are all more or less inimical to the wireworm.

Leather jackets are the grubs which develop from the eggs of Daddy Longlegs, or Crane Flies, *Tipula oleracea* (fig. 437). These flies may be seen in quantities, especially in autumn, depositing their eggs upon

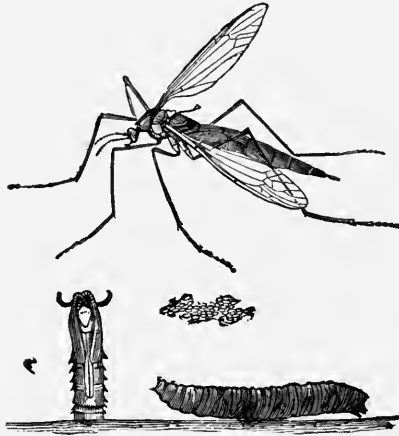


Fig. 437.—Daddy Longlegs (*Tipula oleracea*).  
Mature fly, eggs, grub and pupa.

meadows, clover leys, and marsh-lands. The grubs grow to rather over an inch in length, and possess exceedingly tough skins. They do enormous damage by gnawing through the roots of plants just below the surface of the ground. Amongst the preventive or remedial measures adopted in the case of this pest are drainage, the removal of neglected herbage, the maintenance—by suitable manuring—of a vigorous and healthy growth of the crop, and the consolidation of the land by means of rolling.

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## CHAPTER II.

### ON ARTIFICIAL GRASSES, OR GREEN FORAGE CROPS.

**T**HE term artificial grasses is usually applied to clovers and their allies. The clovers (*Trifolium*) belong to the natural order Leguminosæ, which also includes trefoil, lucerne, sainfoin, vetches, peas, beans, &c., all of which have a strong family resemblance in their nutritive characters and in their manurial requirements. The

species of *Trifolium* usually cultivated are named in the following table:—

Botanical Name.	Common Name.	Colour of Flower-head
<i>Trifolium repens</i> . . . . .	Dutch clover . . . . .	White.
<i>Trifolium pratense</i> . . . . .	Broad clover . . . . .	Red or purple.
<i>Trifolium pratense perenne</i> . . . . .	Cow-grass . . . . .	Do.
<i>Trifolium hybridum</i> . . . . .	Alsike . . . . .	Pink and white.
<i>Trifolium incarnatum</i> . . . . .	" <i>Trifolium</i> " . . . . .	Crimson.
<i>Trifolium minus</i> . . . . .	Yellow suckling clover . . . . .	Yellow.

The WHITE or DUTCH CLOVER (*Trifolium repens*, L.), or Honey-suckle clover, is a valuable double-cut clover. Clovers are spoken of as single-cut when they do not make sufficient growth, after being fed off or cut once, to be allowed to stand again. The white clover throws up a fair aftermath, but is not always allowed to remain because it becomes too rank in flavour, and can only be eaten with safety by old sheep. The plant is short in growth and close-lying, hence the crop is never mown for hay. But it grows very thickly upon the ground, and affords a large amount of feed. It is, in fact, the most nutritious green food grown on the farm, and is specially valuable for lambs, or for "topping-up" sheep for the butcher. As illustrating its high feeding value when fed off the first time, we may mention our experiments, extending over five years, on the feeding of the crop by sheep: some of the sheep received no cake, but two pens of ten each received every year from ½ lb. to ¾ lb. of the best decorticated cotton cake and maize respectively, per day, and in each year those receiving no cake or corn made as great increase as those which did. After the first feeding, however, when the food had become stale, those with cake and corn always did best.

The greatest amount of feeding matter is present when the plant comes into flower. There is one great risk in feeding off the crop, and that is, that the sheep consuming it are extremely liable to become hoven or blown, which is a form of tympanitis (see Book the Sixth) caused by the too rapid generation of gas in the stomach,—the clover fermenting almost directly after it is eaten. There is the greatest risk of this on windy days, but it is also dangerous to feed the clover while there is frost on it. The best course to adopt is to turn the sheep on to the clover while their stomachs contain plenty of other food, when they will not eat ravenously, whilst the small quantity of clover they consume will digest safely.

In districts where the crop is sown without an admixture of other seeds it is usual to allow a portion to go to seed. If the crop is fed off at all, the animals should be off it by the end of the second week in May. It is very risky as a seed crop, and now that prices are low owing to foreign importations it is rarely a profitable crop. The best crops for seed are grown on light loams, but the heaviest feed is obtained on the medium loams. The clover is sown in a cereal crop; in the 4-course rotation it is sown in oats or barley. If the land is free from weeds, especially annuals such as knotgrass or hog-weed (*Polygonum aviculare*), it is advisable to sow the seed early, even at the time of

sowing the corn, but if the land is weedy it is better to hoe the corn first and then sow the seed. When sown without admixture with other seeds, from 12 to 14 lb. are required per acre. It is best sown broadcast, but may be drilled if the coulter is placed not more than 5 inches apart. It should not be buried deeply, therefore it is best harrowed in with very light seed-harrows. As it is not affected by clover-sickness, it supplies a very good change in the clover sub-rotation of an ordinary rotation. It is benefited by the direct application of manures, which is not the case with all clovers. It is rarely possible, without going to very first-class seedsmen, to get a sample entirely free from an admixture of cranesbill "seeds" (*Geranium* sp.), and, more frequently than not, these are present in very great quantity. Dutch clover-seed should be of a golden yellow colour, and somewhat heart-shaped: the cranesbill is in form more kidney-shaped, and is of a ruddy-brown to a liver colour. Sorrel "seed" is a common impurity, but may be easily distinguished by the triangular shape, and hard, glabrous, brown skin. White clover springs up naturally where land is rich, and where there is a considerable quantity of lime present in the soil, and this plant is one of the surest indications of a rich soil. It should always be sown when land is laid down to grass. It is by far the most abundant leguminous species in the prime old grazing pastures of England, in which it contributes materially to the formation of a close rich bottom herbage, thriving under continuous treading and grazing. Its specific name, *repens*, refers to its creeping habit, numerous prostrate stems or stolons being given off at the crown.

RED OR BROAD CLOVER (*Trifolium pratense*, L.) is known also as purple clover or meadow clover. When the land will carry the crop no opportunity should be lost of sowing this most valuable variety. Unfortunately it cannot be grown with great frequency, as the land becomes "clover-sick" and will not support it. Clover sickness is now believed to arise from the attack of a minute eel-worm (*Tylenchus devastatrix*, fig. 438), but it has hardly been satisfactorily proved whether this parasite causes the disease, or whether, owing to the enfeeblement of the plant from want of proper food, the pest invades the plant when it is in a dying condition, the attack in the latter case being the effect rather than the cause. However this may be, red clover dies out if the land is too frequently cropped with it, whilst if the land is in a healthy condition as regards draining, and has not been cropped with this clover for a number of years, it can be relied upon to afford an abundant yield. The lighter soils are the most susceptible to clover-sickness, and on gravel-loams with an open subsoil it is not safe to attempt to grow the crop more often than once in 12 years. On strong loams with retentive subsoils it is permissible as often as once in 8 years. Attempts are made to grow it as frequently as once in each rotation of four or five courses, but rarely with success. When the crop is taken with such frequency it is in mixture with other seeds, such as ryegrass or the single-cut clovers.

The best means of insuring a crop of clover in each rotation



is to establish a sub-rotation, so that Broad Clover comes in the first four years, White Clover in the second four, and Alsike in the third four. As the two latter are not affected by the sickness, and do not tend to make the land sick, the usual quantity of sheep-food may be secured without great risk. When sown free from admixture with other seeds, from 12 to 16 lb. of seed may be used per acre, though even less can be drilled, as usually a larger percentage of seeds may be relied upon to grow. The seed should be of a dark purple colour, though it is impossible to find a sample in which all the seeds are of one colour, as all the flower-heads do not ripen at one time. Those not so well ripened are yellow in colour, and will in all probability germinate, but they are not so robust as the purple. Brown seeds are dead, and therefore useless. The most injurious weed-seeds commonly found in a sample of broad clover are those of rib-grass or plantain (*Plantago lanceolata*) and of dock. These sufficiently resemble the true seed in size and density as to be very difficult to separate, although they are quite unlike it in shape.

The seed of plantain resembles a very small polished date-stone; that of dock is triangular like buckwheat.

Dodder is a common seed in this kind of clover, but is very small and brownish. It is, perhaps, the worst of all weed-seeds in clover, for after the seed has germinated in the ground the young seedling attaches itself to a clover plant, and thenceforward lives as a parasite, gradually spreading from plant to plant (fig. 439) until a patch some yards in diameter is destroyed by a single dodder plant. Nothing but the most careful sifting on a fine sieve, which allows the dodder to fall through, but retains the clover, will free a sample of clover seed from this pest.

In selecting seed for sowing, great care should be taken that none of the impurities referred to are present, as they all tend to spoil the hay, and to make the land foul in the future. Red clover seed may be sown at the same season as white clover, and under the same conditions, but as red clover is a big plant it is at times difficult to harvest the crop in which it is sown if the clover is put in early. This is particularly the case when the clover is sown in barley, for in a wet harvest it is

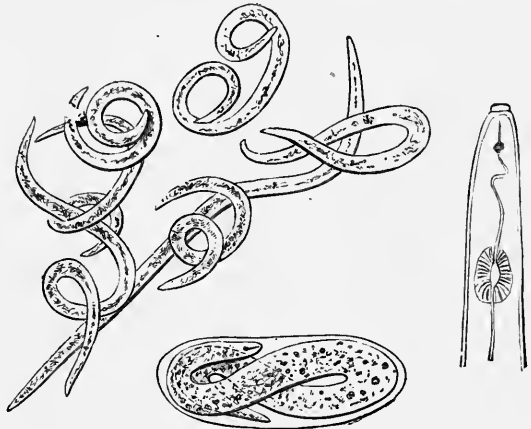


Fig. 438.—Stem Eelworms

(*Tylenchus devastatrix*). Greatly magnified. Also, Embryo in egg, and (on the right) anterior end of female showing mouth spear.

impossible to get in a crop of barley in an unstained condition if the clover is tall. On the other hand it is certain that heavier crops are grown in the following year when the seed is sown early, therefore the farmer must settle in each case whether he thinks it will answer his purpose best to sow the clover seed at the same time that the corn is drilled, or to postpone it until the corn is up. When the latter is done an opportunity is afforded of hoeing the corn, which is a decided advantage, but the risk of loss of plant during a summer drought is great. We find it advisable to put the seed in at both periods, so that the whole crop may not be lost. For preference we put the clover in early with wheat or oats, which are necessarily cut a considerable time before they are fit to stack; whilst we sow those clovers which are seeded in the barley after the latter crop is up.



Fig. 439.—Clover Dodder.  
(*Cuscuta Trifolii*.)

Clover is fit to stock with sheep in May, and, as a rule, is ready for mowing in June, being fit to cut some little time before the meadows in the same localities. Two cuttings may be relied upon in the first season (the year in which the seed is sown does not count; the first year in the life of the clover crop is that which comes after it has stood a winter, —until then the crop is

spoken of as “young seeds”). The first cutting is taken in June, and the second in August or September. Clover hay must not be tedded, or the nutritious leaves are knocked off; the process of haymaking, therefore, chiefly consists of gentle turnings. It is not uncommon in wet seasons for the crop to afford three feedings for sheep. Red clover will stand two or more years on good soils, but on land predisposed or liable to clover-sickness it is very bad policy to leave it more than one season. It is found to act as a restorative crop to land even when the whole of the crop above ground is carted off, a large amount of plant food being stored up in the roots and necks of the clover plants (*see page 1022*). There is no crop of greater value on the farm, and land which is capable of growing good crops with frequency is always valuable for corn-growing purposes and will carry a pasture readily if seeded down.

COW GRASS (*Trifolium pratense perenne*) is a variety of the Red Clover, which is much slower in coming to maturity than the common form. It grows a very heavy crop, which is fit for mowing some weeks later than the ordinary red, and hence yields but little after-math, as the season is too far advanced for it to make a second heavy growth, it is therefore called a single-cut clover. The seed is indistinguishable from that of the common red, and the cultivation is exactly similar. It is, however, better suited for long leys, and is recommended in mixtures selected for sowing down land. It is not so liable to be affected by clover-sickness as the common variety, but it is not unusual for crops to be destroyed by this malady. Its chief value in arable culture arises from the fact that it is at its best at the period when the common variety has been cut, and is not fit to stock again. A few acres of Cow Grass are therefore especially useful at a critical time in a droughty season.

ALSIKE (*Trifolium hybridum*, L.) has come into prominence during the last thirty or forty years, but it is not likely that its cultivation will extend. It is a single-cut crop, and its chief value arises from its immunity from clover-sickness, which renders it useful as a change crop in the clover rotation. It grows freely on most soils, but is perhaps grown to the greatest advantage on the medium loams. The seed should be of a dark green colour, as the lighter-coloured samples are weaker in their powers of germination. It is a seed which is often sold with a large quantity of impurities, such as sorrel, wild geranium, and wild pansy (*Viola* sp.) seed. It is sown at the same times as are the clovers previously mentioned, and from 12 to 16 lb. are seeded to the acre. Alsike is named after the village of Syke, near Upsala, in Sweden.

CRIMSON CLOVER (*Trifolium incarnatum*, L.), or Italian clover, commonly called "trifolium," is emphatically a single-cut clover, for, whereas some of those so-called are often allowed to grow a small after-math, this is never left for a second cut. It is most commonly grown as a catch-crop. In Wilts and Hants, where the climate and soil are particularly suited to its cultivation, it is grown to some extent on all farms, but in colder and later districts it is only occasionally sown, and in the extreme North it is never cultivated. The land requires less preparation for this crop than for any other grown on the farm. All that is necessary is for the seed to be sown on a cereal stubble, after which it only requires harrowing in: ploughing is prejudicial to its growth, as it requires a firm root-hold near the surface. The sowing should be commenced as soon after the corn crop is harvested as possible, and the trifolium will be fit for feeding in May. From 18 to 24 lb. of seed are sown per acre. This plant is not affected by clover-sickness; and, as it matures so quickly, it is found to be very useful for re-placing any plants of clover sown in the spring which have failed during summer, whether the loss of plant is due to drought or to smothering by the corn crop.

**YELLOW SUCKLING CLOVER** (*Trifolium minus*, Sm.), sometimes called lesser yellow trefoil, is a small annual yellow-flowered species, of somewhat slender habit. It has an appearance not unlike that of yellow trefoil (*Medicago lupulina*), but its flower-stalks are more slender. The trefoil, moreover, has a black seed-pod, and the whole plant is hairy, neither of which characters is true of the yellow suckling. *Trifolium minus* is often grown with rye-grass, in association with which it makes excellent hay, especially on adhesive land. It produces abundance of seed, and, if left untouched till after midsummer, is self-seeding.

**MARL CLOVER** (*Trifolium medium*, L.), sometimes found in old pastures, is the cowgrass or zigzag clover of botanists. It is very rarely cultivated, but springs up spontaneously on marly soils. It should never be sown, as its lateral extension underground is extremely rapid, and when once introduced upon land it is almost impossible to get rid of it.

**BIRDSFOOT TREFOIL** (*Lotus corniculatus*, L.) is a native of chalk and other limestone districts, and thrives on dry sandy soils. Its head of bright yellow flowers, red when in bud, is very beautiful, and, after flowering, the pods spread out like a bird's foot. It is a smooth plant, and is readily eaten by cattle and sheep. The nodules (*see* page 1022) concerned in the acquisition of atmospheric nitrogen by leguminous plants are readily seen upon the roots of this plant.

**TREFOIL OR YELLOW CLOVER** (*Medicago lupulina*, L.).—This is not of the same genus as the clovers already discussed, but its cultivation and appearance are such as to permit of its being included among them in an agricultural work. It does not possess the high feeding properties of the true clovers that have been described, and in some districts is considered little better than a weed. In other localities, especially on the thin chalk soils, it is frequently sown in conjunction with other seeds for short leys. It springs up spontaneously on many thin soils, especially on sandy loams. In newly laid down pastures it is almost always present, and grows freely during the period when the land is in very poor condition—from the third to the tenth year in ordinary cases. When the pasture begins to form a rich turf it is gradually displaced by white clover, and Sir John Lawes has stated that he takes this circumstance as the barometer of the condition of his new pastures. When the trefoil has disappeared he considers his turf possesses the desirable characteristics of an old pasture. It cannot be recommended as a crop on good land, as much heavier and more nutritious crops of other clovers can be grown in its place. On thin soils which do not support heavy crops of the better clovers it is found to be useful when sown in a mixture to produce short leys. The name of Black Medick, by which this plant is also known, refers to its head of black spiral seed-pods, easily noticeable in the late summer months. *Medicago lupulina* is often called "hop" by farmers.

**LUCERNE** (*Medicago sativa*, L.) was introduced into British hus-

bandry about the middle of the seventeenth century. It flourishes luxuriantly in deep, rich, friable loams, but it will thrive in sound mellow soil of any kind where drainage is good; and it does particularly well when there is a large quantity of lime present in the soil. Where such is not the case, and the substrata of the soil vary in quality and consistence, the growth of the roots will be checked, and the plants rendered poor and weakly, if not totally destroyed. It is useless to attempt its cultivation on wet, marshy, or clayey ground, for it will be injured, if not destroyed, by the stagnation of the water around it. Land in which it is sown must be kept as free as possible from weeds, otherwise the luxuriance of its growth will be greatly impeded. In order to clear the land for lucerne, two successive crops of turnips or carrots are recommended. Before sowing, the soil should be brought into the finest condition of mould that is possible, and this is best effected by previous ploughing and harrowing, or the growth of those plants which tend most to render the soil fine and mellow. The manure, which should consist of a rich and rotten compost, ought to be thoroughly incorporated with the soil before the sowing commences, otherwise it will occasion premature rankness in the early plants, which is not unfrequently followed by decay. Top-dressings should be applied at different stages of its growth, and for this purpose gypsum, ashes, lime, and liquid manure composed of the drainage of the stable or dunghill, may be advantageously employed. Wherever the plants fail, their places should be supplied by transplanting. The crop should be frequently hoed, so as to maintain the most perfect state of even garden cleanness. With due attention to all these points, lucerne will stand for a number of years, and may be cut as often as three times in each season; but, in order to secure a prompt, vigorous, and luxuriant after-crop, it should be mown before its flowers are developed.

Lucerne may be either drilled, or propagated by transplanting. It is not advisable to broadcast the seed, as there is no opportunity of cleaning the land, without which the crop suffers so severely that it cannot be allowed to remain down so many years as would otherwise have been possible. The season for sowing is towards the middle or end of March, or not later than April. If sown broad-cast, 20 lb. of seed (which should, if possible, be *new*) will suffice for one acre; when drilled, 6 lb. will be enough if the seed is deposited in equidistant rows of 2 feet. As soon as the grain is sown and harrowed, the lucerne should be sown, and a light harrow passed over it. Where lucerne is sown with a view of being transplanted, the seed should be deposited in the ground early in the spring, and carefully hand-hoed until August, when the sprouts will be sufficiently large to be transplanted. After this they will require but little attention until the following year, excepting that it will be advisable to hoe the transplanted crops once or twice during the intervening period. Lucerne is an exceedingly deep-rooted plant, and is consequently well qualified to withstand drought, and therefore to thrive in dry soils and dry climates. A small proportion of lucerne is recommended in mixtures of seeds for permanent pasture in all cases where the soil or subsoil is calcareous.

While it lasts it will aid in storing up fertility. Lucerne is mostly utilised in green soiling, and is but rarely made into hay.

SAINFOIN (*Onobrychis sativa*, L.) grows luxuriantly on dry chalky soils, where it flowers in June and July; but its produce is inferior in quality to that of lucerne. It will flourish on light sandy soils, and on almost all soils of a mixed character, provided there is a calcareous bottom.

Sainfoin requires a clean soil. The seeds should be *fresh*, and sown towards the close of February, or early in March. The quantity varies from 4 to 5 bushels per acre, broadcast, according to the nature of the land, although 4 bushels are, in general, fully sufficient. In the drill culture, 3 bushels are enough. When the seed is "milled," that is, freed of its husk or pod, it is only necessary to drill half a bushel per acre. Sainfoin may be sown with barley; and as it does not attain its full growth until the second year, it is often mixed with trefoil, or yellow clover, in order both to increase the first crop and to check the growth of weeds until the sainfoin has taken deep root.

During the first year no cattle should be allowed to graze on it, as their feet will injure it; nor should it be fed down by sheep in the succeeding summer, as they are apt to bite out the tops of the roots, and thus to destroy the heart of the plant, the growth of which would be immediately checked. In the following summer, however, a crop of hay may be taken, and the aftermath fed down with stock of any description. The period during which it is allowed to remain depends upon the quality and condition of the soil, and the care taken to keep it clean and to manure it; though upon the latter point, it may be observed that, except as mere top-dressing, manure has less effect upon sainfoin than upon any other "grass," in consequence of the roots seeking their nourishment at a depth to which it cannot reach. It should not be sown on the same land more than once in twenty years. It, at one time, could be relied upon to stand for seven or more years, but on land where it has been grown with frequency it cannot be depended upon for more than five years, and often becomes unprofitable after the third. Valuers in Flants and Wilts allow for three years.

TARES OR VETCHES (*Vicia*).—There are two varieties of the common tare (*V. sativa*, L.), called *spring* vetches and *winter* vetches. The spring tare is usually sown in March, April, or early May, with or without a small quantity of oats or barley; and the winter tare in September (the earlier the better), in the proportion of from five to eight pecks of seed per acre, and commonly intermixed with a bushel of rye. The winter tares are often sown after one ploughing only. A second ploughing, so as thoroughly to prepare and mellow the ground, would be advisable, but this would entail loss of time which must be avoided if possible, as an early start is most important. For the spring tares, the land should be ploughed once before winter, and again cross-ploughed in the spring, and after they are sown, the land should be

rolled for the convenience of mowing. Whether winter or spring tares are to be cultivated, the land cannot be too clean, but successful crops are grown on very foul land; in fact, owing to the dense growth of the crop, it is often sown on foul land to smother the couch and other weeds. Many farmers maintain that it destroys couch; whether this be so or not, it certainly checks the growth and renders subsequent cleaning more easy. The tares should not be cut till the pods are formed, though long before they ripen. Both varieties of tares are of essential service in soiling cattle of every description; especially the winter tare, which comes into use just when the turnip crops fail, and affords a succulent food to ewes and lambs. Both are very nutritious, and supply a large quantity of fodder of which all animals are fond. Pigs may be fattened upon them. The milk of the cow is enriched and increased by them, and they are extensively employed in the feeding of horses. They do not require a rich soil, but are always finest where the soil contains a fair quantity of nutritive matter; clays, provided they are not too wet, will carry them. A succession of sowings should be put down in order to have a like succession of cuttings for forage in spring and early summer. Vetches are usually sown down with a little rye, because the latter affords to the stalks supports to keep the vetches off the ground, and thus adds greatly to their produce. When the season delays oat sowing for a crop, oats and tares may be sown for green fodder; when frost comes the remainder may be converted into silage.

In some counties the winter tare is cultivated as pasturage for horses, and is eaten off sufficiently early to admit of turnips being raised the same year. In Sussex, spring tares have been found to succeed after the winter tares have been got off, thus affording a succession of rich pasture from May to November. They produce abundance of seed, which the farmer will do well to collect, and keep separate, for, on account of the perfect resemblance which the seeds of the two varieties bear to each other, they are liable often to become mixed.

FURZE (*Ulex Europæus*, L., nat. ord. Leguminosæ).—It is only within comparatively recent years that the furze, gorse, or whin, which used to be regarded simply as an article of fuel, or a temporary hedge, or a preserve for foxes, has been utilised as food for cattle.

The furze was first brought into notice by Sir Edward Mostyn and Mr. Wynn, who reared large studs of young horses, and fed them almost wholly during the winter on the clippings of their extensive gorse covers. The use of the plant was soon extended to cows and sheep, and always with good effect. There is not a case on record of injury resulting from the use of furze. During the Peninsular war, and in the early part of the winter of 1813, the horses of the light cavalry subsisted for many weeks on gorse gathered by the men, and chopped fine with their sabres; and the animals not only continued in excellent condition for service, but got fat on the food.

Furze is seldom made an object of direct cultivation in any part of the country, yet there can be no reason why it should not become so.

It might be cultivated in light waste sandy soils by sowing its seed in February, March, or April, in the proportion of 6lb. per acre. About October, or perhaps a little earlier in the following year, it may be first mown, and then may continue to be cut at intervals until Christmas, or even until the middle of March. It will go on growing almost continuously. When used, a little salt should be added to it, and it should be mixed with chopped straw or hay in the proportion of one part to ten.<sup>1</sup>

Its effect on dairy cows has been put to the test. In a dairy farm near Birmingham of 100 cows which supplied that town with milk, the land was poor, light, and dry, and such as, in the common mode of culture, would be insufficient for producing fodder for the stock of the occupier; he therefore sowed 100 acres of it with furze-seed. He never let the plant rise into a shrub, but continually mowed it for his dairy cows. When bruised in the mill it was mixed with a certain portion of chaff, chopped hay or straw, wash and grains, but the furze formed the principal portion of the diet, and increased the quantity and improved the quality of the milk. Other remarks upon furze will be found in Book the First, page 178.

The results of an instructive experiment on gorse as a food for sheep are given by Dr. J. Augustus Voelcker in the Journal of the Royal Agricultural Society (3rd series, vol. x., 1899, p. 567).<sup>2</sup>

**SPURREY** (*Spergula arvensis*, L., nat. ord. Caryophyllaceæ).—The common or corn spurrey is an indigenous plant, flourishing in corn fields and sandy situations, where it flowers from July to September. Its culture has hitherto been but little, if at all, practised in this country, though it is eaten with avidity by many animals, and particularly by sheep. Spurrey continues green until a late period in autumn, and often throughout the winter, on which account it has long been

<sup>1</sup> Working horses do their work well when fed with furze mixed with cut wheat straw, a quatern of oats per day, and a handful of salt, from the first of November to the end of March. Cows may likewise be maintained in good condition for the same period with a well-heaped peck of it in the morning and another at night, thoroughly bruised and mixed with an equal quantity of cut hay; the flavour of the butter yielded by them is particularly good.—*Farmers' Magazine*, vol. x. p. 63.

<sup>2</sup> At the Society's Experimental Farm, at Woburn, Beds, there is on the hillside of one of the fields a very poor and sandy piece of land, upon which no satisfactory crop could be got to grow. On this, as an experiment, gorse was drilled in May, 1897, the variety tried being that known as "French" gorse. No manure was used, and a barley crop was first put in, gorse being drilled between alternate rows of the barley, and thus in rows about 18 in. apart. The barley was once more a poor crop, but the gorse came up fairly regularly; the plant was just visible, about two or three inches high, through the winter, and it began to shoot out at the end of April, 1898. Two horse-hoings during the summer was the only cultivation required, and by October the gorse was ready for cutting. The crop cut during the winter weighed 11 tons per acre. It was decided to ascertain how the gorse would do for sheep-feeding, and, chiefly, how far it would replace roots, and so come in usefully in the event of a failure of the root crop or a short supply of roots. There being no machine on the farm for preparing the gorse, it had, after cutting, to be sent some distance off to a farm where there was a proper gorse-cutting machine. Two lots of sheep, Hampshire and Oxford cross, about ten months old, fourteen in each pen, were selected, and to both lots linseed cake and hay chaff were given. To one lot roots were supplied, as much as the sheep would take, while to the other, gorse was fed *ad libitum*, and the rest of the diet made up, if necessary, with roots.

The results of the experiment showed very clearly that the replacement of roots by gorse could only be made to a limited extent, and that, at most, 2½ lb. of gorse per head daily would be consumed, taking the place of say 6 lb. of roots. But, with this limitation, the gorse did exceedingly well as a food, and exercised a pronounced benefit upon the sheep, alike as regards their general health, their increase in live weight, and the excellence of the meat produced, so that the use of gorse as an additional food for sheep is decidedly to be recommended.



cultivated in Flanders, where it is sown immediately after wheat, by one ploughing of the stubble, and soon affords a tolerable pasture for cows; but it is said to communicate an unpleasant flavour to the butter. Most farmers regard it as little better than a weed, but it has been cultivated upon light sandy soils for conversion into silage.

**CHICORY** (*Cichorium Intybus*, nat. ord. Compositæ), also called Common Wild Succory, is a perennial plant, indigenous in this country. It grows on most soils of a loamy description, and even on some of the more light and brashy sorts of land. Almost every poor soil not too retentive of moisture will carry it; and it is very hardy, standing the severest cold. Its broad leaves cover the ground and shelter it, while its roots strike deep into the soil, and loosen it. Chicory is useful early in the spring, and may be cut for forage several times in the year. Some have recommended that it should be sown with other plants; but the manner in which it grows—like a lettuce—points to a different and more suitable mode of cultivation, namely, by itself, and in rows.

The best seed is that which is obtained by the farmer from his own plants, and, as they produce seed in great abundance, it may be easily collected by hand. The mode of sowing varies according to the object for which it is grown. Thus, for feeding cattle, it is usually sown in conjunction with oats, or other spring corn, at the season the latter is put in the ground; but for soiling it is sown alone, from the second or third week in March until the close of summer—the earlier the better, on account of its hardy nature. The quantity usually sown is about 10 lb. per acre; it will grow on any soil, but the crop is uncertain. As a forage plant it is best to grow it alone, not with other plants. Chicory is much cultivated on the Continent both as a forage and as a salad plant.

For the first year one or two cuttings or mowings will be sufficient. These may, in subsequent seasons, be repeated three or even four times, beginning in April or May, and cutting every second month till October.

**PRICKLY COMFREY** (*Symphytum asperrimum*, nat. ord. Boraginæ) is a Caucasian plant, allied to the common comfrey, a coarse hispid herb that grows beside English streams, and used to be boiled and eaten by cottagers. Prickly Comfrey attains a height of 4 to 5 feet, it has very rough coarse leaves, and its flowers are dull white, reddish, or blue. In England it is raised exclusively from roots, the sets costing about 5s. per 100. It is of such rapid growth as to permit of cutting for fodder four times in a season. It has about the same feeding value as green mustard or turnip-tops, and it affords a change of food for cattle. Being a deep-rooted plant it withstands drought. Enormous yields, up to 80 tons per acre per annum, have been recorded. As the plant is perennial, its cultivation requires but little care after the sets are once established. Cattle, sheep, and especially horses, although they prefer other food, soon acquire a taste for it in the green state. Before feeding, it should be allowed twelve hours to wither and soften. When dried it affords a substitute for hay to mix with straw for chaff-cutting.

## CHAPTER III.

ON THE CORN AND PULSE COMMONLY CULTIVATED FOR THEIR GRAIN  
OR STRAW, OR AS GREEN FORAGE.

WHEAT still holds, and is likely to hold, an important position among English crops, and notwithstanding the large quantity of land recently laid down to pasture, there are still about  $1\frac{3}{4}$  million acres of this crop grown annually in Great Britain, the area under wheat in England alone having been 1,537,208 acres in 1907. It is the only crop which has practically an unlimited market. All other crops have to meet a limited demand, and if their cultivation is extended even but very little, the supply exceeds the demand and there is a slack sale for a portion of such crop. The straw of wheat is undoubtedly valuable both as food and litter to the stock-master, and can ill be spared by him. The many varieties of wheat are marked by variations in the form and colour of the chaff and kernel (or grain). In the first place there are both red and white wheats, the name being applied to the colour of the grain, and these form the chief sub-divisions; but there are also red wheats with white chaff, and white wheats with red chaff. The chaff may be awned or beardless, and smooth or rough.

As a rule red wheats are preferred on heavy soils, and white wheats on good light soils. Red wheat is the more vigorous in the straw and can stand a cooler climate and wetter soil than the white; but the white is superior in quality. It is difficult to state which is the best universal wheat, even if there be such a thing; we are inclined to think there is not. One of the safest guides in making a choice for a particular locality is to ascertain what is the most popular wheat in the district, for in all probability this will prove to be the best. New varieties that are also good are introduced from time to time, so that if the rule were too strictly adhered to there would be but little chance for a better variety. Nevertheless, we would advise that any change should be made with caution, and that only small breadths should be planted with a new variety until it has been proved to be deserving of a wider area. It is necessary to ascertain that both soil and climate are suitable. Even on the same soil climate has so much effect, that a variety which suits a soil for one season, or even for a succession of seasons, may not be profitable to grow in another year, if the weather is not similar.

Of the varieties found most successful on cold land, Rivett's Cone, a bearded coarse variety, with coarse straw, is the heaviest cropper, though owing to its harshness the straw is unfit for feeding, but it is

particularly valuable as litter on account of its toughness. Square-head, Golden Drop, Defiance, and many others do well on strong land and on medium loams. Talavera, Essex Rough Chaff, Hardcastle, &c., are good white wheats. So too, almost without exception, are the varieties brought out by the leading cereal seed firms.

It is impossible here to enter into the various methods of preparing the land for wheat, for they are almost without end, owing to the different crops which it follows, and to the great variety of soils on which it is grown. Strong soils are best suited for its growth, and these require liberal manuring. Tith wheats should be sown as early after harvest as possible, but the greater part of the crop, which follows peas, beans, clover leys, and in some districts early roots, may be considered to be sown in good season if it is seeded any time between Michaelmas and the end of November. The seed should be put in on a firm seed bed: six pecks will suffice on a tith seeded in September, but the same land, if it were after a ley and not seeded until November, would require 9 or 10 pecks. Occasionally as much as 3 bushels (12 pecks) are sown, but it is not to be recommended, as the crop is liable to be grassy, whilst the grain will be small.

Although some authorities have argued in favour of the specific identity of all kinds of wheat, Metzger recognized the following seven species:—

- |                                     |                            |
|-------------------------------------|----------------------------|
| 1. Ordinary or soft wheat . . . . . | Triticum sativum, Lam.     |
| 2. Plump wheat . . . . .            | Triticum turgidum, L.      |
| 3. Hard wheat . . . . .             | Triticum durum, Desf.      |
| 4. Polish wheat . . . . .           | Triticum polonicum, L.     |
| 5. Spelt . . . . .                  | Triticum Spelta, L.        |
| 6. Starchy wheat . . . . .          | Triticum amyleum, Seringe. |
| 7. One-berried wheat . . . . .      | Triticum monococcum, L.    |

M. Henry L. de Vilmorin, of Paris, the highest modern authority on wheats, would reduce these species to five, by including *T. polonicum* with *T. durum*, and *T. amyleum* with *T. Spelta*.

More than two-thirds of the cultivated varieties are soft wheats of the species *T. sativum*. Of forty-eight of these, enumerated in M. de Vilmorin's work, "Les Meilleurs Blés," forty-one are beardless, and the remainder bearded. The latter are further divided according as they have white ears or red ears, Shirreff's white being an example of the former and red-bearded autumn wheat of the latter. Of the beardless soft wheats a triple division is made according as the ears are white, reddish, or red; and the white and red varieties are again divided into groups determined by the circumstance as to whether the ear is smooth or downy. Of the soft, beardless wheats, however, only two of the white-eared varieties are enumerated as having downy ears, and only two, also, of the red-eared sorts. The final division of the smooth-eared kinds, whether white or red, is determined by the colour of the grain—either white on the one hand, or red or yellow on the other. Among the varieties with white grains, smooth white ears,

and beardless, are mentioned White Victoria, Autumn Chidham, Hunter, Trump, White Spring Chidham, Talavera. An example of the yellow or red grained, reddish-eared, beardless, soft wheat is afforded by Hallett's. Of the smooth red-eared beardless forms with white grain, the red-eared Autumn Chidham is an example. Of the smooth red-eared beardless form with red grain there are enumerated, amongst others, the Scottish red or blood red, Prince Albert, and Browick.

Numerous modifications are induced in the wheat plant by changes of climate. In dry countries, exposed to high winds, the leaves become narrow, the stem or straw very flexible, the ears awned and sometimes downy; these characters enable them to resist the effects of winds and drought. The wheats of humid countries develop, on the contrary, broad leaves, whereby they can transpire water vapour more abundantly; such are the Autumn Victoria, the Prince Albert, and the Browick wheats. Thus, hard wheats have become almost exclusively the wheats of warm dry countries; spelts and starchy wheats those of thin soils and mountainous districts; plump wheats those of table-lands or of imperfectly drained valleys; whilst the wheats of the better class, in yield and quality, are characteristic of alluvial plains and fertile valleys.

In order to increase the yield of wheat on the one hand, and to improve the quality on the other, M. de Vilmorin makes a number of useful suggestions. First, he says, economise the seed and so keep for consumption much that would otherwise be used for sowing. With the drill it is easy to sow at the rate of about a bushel and a half per acre; this, it is calculated, would give about 170 seed grains to the square yard. Prepare the grain carefully beforehand by pickling with a solution of blue vitriol (blue stone, or sulphate of copper), so as to render it, as far as possible, proof against mildew and other fungus pests. Endeavour by hoeing, wherever and whenever possible, that the wheat crop alone shall benefit by the nutrient resources of the soil; it is but rarely that the expense of this operation is not more than repaid in the increase of crop. Sow wheats of heavy yield—preferably those whose grain is of high quality—in rich soils, particularly in those of valleys and alluvial plains, where there is naturally supplied a mixture of the various mineral elements suitable to the production of the choicest wheats. Employ for soils which are less rich, and in climates which are more harsh, the varieties with long grain, bearded or beardless. With equality of yield, preference should always be given to varieties of superior quality,—those, for example, which give least bran and most gluten. Generally speaking, the variety sown should be selected with reference to the state of fertility, natural or artificial, of the soil on which it is to be employed; it is almost as grave an error to sow a wheat of low yield in a very good soil as to sow an improved variety in a poor soil,—in neither case is the yield likely to defray the cost of cultivation. Do not, however, substitute a new variety for one which has already been found to give fair

results until the new kind has undergone a satisfactory comparative trial.

Wheat is liable to the attack of numerous insect pests. The roots are infested by wire-worms and leather-jackets; the stems and leaves suffer from the ravages of the gout fly, the corn saw fly, the wheat bulb fly, and the Hessian fly; whilst the ears and grain are preyed upon by the grain aphids, the corn thrips, and the orange-coloured maggot of the wheat midge. The Hessian fly (fig. 440) attacks both wheat and barley (fig. 441), but it has not hitherto proved anything like so destructive a pest in Britain as it has in North America and on the European continent. Our illustrations of this and of several other pests are taken from Miss E. A. Ormerod's "Manual of Injurious

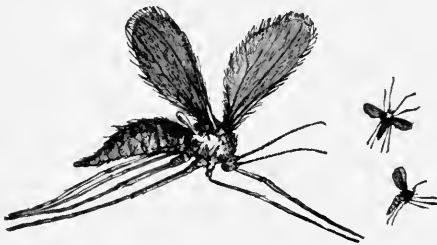


Fig. 440.—Hessian Fly.

*Cecidomyia destructor* (the small figures shew the natural size).

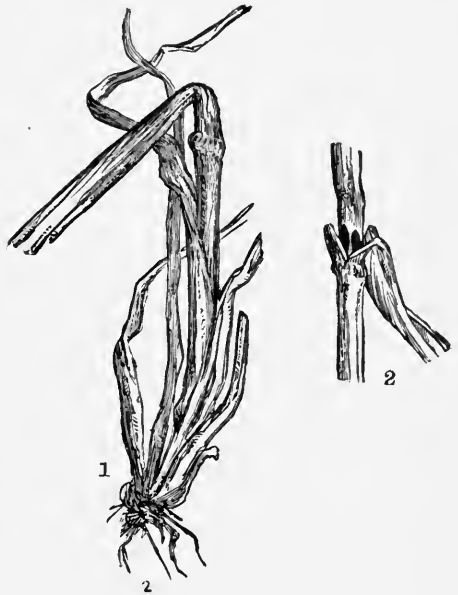


Fig. 441.—Barley-stem attacked by Hessian Fly.

1, bent down; 2, showing the chrysalids, or "flax-seed" stage.

Insects" (London: Simpkin, Marshall & Co.), which valuable treatise we unhesitatingly recommend to the notice of cultivators who wish to know the best practical means for the prevention and remedy of insect attacks.

**BARLEY.**—Greater skill is required to grow barley than to cultivate any other of the cereal crops. The chief object should be to secure a perfectly uniform mature sample, for without uniformity it is impossible for the maltster to convert the barley into malt to the best advantage, that is, so that he may get it into such condition that the brewer may be able to obtain the maximum quantity of saccharine matter from it. To ensure uniformity of sample, every operation from the time of feeding off the crop of roots, which probably precedes the preparation of the land for the barley, until the grain is finally sacked up to go to market, must be carried out with this view: a mistake at any period may spoil the crop.

Barley commonly follows roots or potatoes, but it may follow almost

any crop, and many growers wisely prefer to take a crop of wheat previously to the barley on land which has carried a root crop fed off by sheep, and is, therefore, in a very rich condition; by such means unevenly fed patches are corrected, and too rank growth of barley is prevented. Unfortunately, only a limited portion of the crop can be grown in this order, owing to the fact that the roots cannot be fed off in time for the wheat to be sown at the proper season. The points to keep in mind are that the land should be broken up as early as possible, and that it should be perfectly drained; that the manuring should be uniform throughout the field; that the seeding should be commenced early, but that it is better to wait a short time rather than to sow when the land is not in good condition, for a perfectly mellow tilth is required; that it should be harvested with special care, and stacked so that stained portions of the crop are not put into the rick with barley of good quality; and that the making up of the sample should be done with the greatest care.

Barley requires thicker seeding than wheat, and from ten to fourteen pecks are generally used, although advocates for thinner seeding may occasionally be met with. When the crop is not grown for malting purposes less care is required, but as it is possible that every field may grow a sample fit for malting, it seems unwise to withhold skill and attention when it is remembered that a malting sample may be worth twice as much as a feeding sample.

Comparing barley with wheat, it has been experimentally proved at Rothamsted that the requirements of barley within the soil, and the susceptibility of this cereal to the external influences of season, are very similar to those of its near ally, wheat; but there are nevertheless distinctions of result, dependent on differences in the habits of the plants, and accordingly in the conditions of their cultivation. Wheat is, as a rule, sown in the autumn, in a heavier and closer soil, and has four or five months in which to distribute its roots and get possession of a wide range of soil and subsoil, before barley is sown. Barley is sown in a lighter surface soil, and, with its shorter period for root development, relies in a much greater degree on the stores within the surface soil. Hence it is more susceptible to exhaustion of surface soil as to its nitrogenous, and especially as to its mineral supplies; and in the common practice of agriculture it is found to be more benefited by direct mineral manures, especially phosphatic manures, than is wheat when sown under equivalent soil conditions. The exhaustion induced by both crops is, however, characteristically that of available nitrogen; and when, under the ordinary conditions of manuring and cropping, artificial manuring is still required, nitrogenous manures are, as a rule, requisite for both crops, and for the spring-sown one, barley, superphosphate also.

OATS (*Avena sativa*), of which there are many varieties, thrive best, as all crops do, on good soils, but are not unproductive on those of inferior quality. The proper season for sowing them is from the beginning of March to the commencement of May, but the earlier the

seed can be got into the ground the better; the quantity per acre, if sown alone and drilled, is from two to six bushels, according to the variety used.

This crop prefers a rich soil, and is much less liable to suffer from over-manuring than is barley. For this reason it is often advisable to sow oats on land off which a heavy crop of roots has been fed. The cultivation of the seed bed need not be quite so thorough as for barley, as the crop is more robust in its growth. The grain should not be allowed to become absolutely ripe before the crop is cut, as it will continue to feed from the straw, and less grain will shell out. Oats require to stand in the field for a long time after cutting or they will heat in the stack, owing to the moisture which is retained in the straw. Oat straw makes valuable fodder, especially if not cut too late.

Comparing oats and wheat together, M. de Vilmorin points out that although the selling price of wheat is higher than that of oats, the last-named grain may leave more profit to the cultivator than the first, for its saleable value covers at least the cost of production. The explanation of this is found in the physiological and cultural characteristics of oats, owing to which the cost of production is reduced below that of wheat. As a general rule, oats sown in spring do not occupy the earth more than from four to five months, and they succeed more easily than wheat, which occupies the land from the beginning of winter. Afterwards, through the abundance and strength of their roots, oats extract from the soil more rapidly and completely the elements necessary to growth and to the formation of the grain. One of their characteristics, most important and useful, is that of being able to grow with profit in ground much less mellowed by cultivation and atmospheric action than that which wheat requires. Earth in a sour condition, and containing a large quantity of organic matter in a state of incomplete decay, will give a fine crop of oats, whilst wheat grown under like conditions would be weak in the straw and would only produce inferior grain.

The husks of oats are of the same texture as the leaves, constituting a true forage, rich in nitrogenous matter, but not in starch, whilst the kernel, composed principally of starch, approaches the nutritive value of other farinaceous grain. Oats constitute a complex food, with properties varying in a considerable measure according to the relative preponderance of the farinaceous kernel on the one hand and the nitrogenous husk on the other. This variability in the proportion of kernel and husk depends in a great measure on the cultivation and the ripening of the crop, but each variety has its particular tendency to produce a grain in which husk or kernel predominates.

Oats sown in cool and rich ground should not be the early kinds, with weak straw, as these will surely fail, or, in any case, give a feeble return. If, on the contrary, the earth is hot and dry, late varieties of large yielding properties should be avoided, as they wither upon the stalk, probably before earing, but certainly before maturing their grain. From the point of view of the richness of the ground, and of the length of time of vegetation which is necessary for a plant to

mature, oats are divisible into three classes: (1) The very early; (2) the medium; (3) the late, which need most abundant nourishment, and, above all, a prolonged time of vegetation.

In selecting oats for cultivation the colour of the grain is an important consideration. In the choice of colour—white, black, or yellow, as the case may be—it is expedient to attach value to local preferences.

Oats are liable to an affection known as “Tulip-root” (fig. 442), from the swollen appearance of the base of the stem, which bears some resemblance to a tulip-bulb, and more still to a “duck-necked” onion. This swelling is usually surrounded by a number of small pale doubled-up shoots. The disease is also known as “Segging” or “Sedging,” from the sedge-like appearance often assumed by the leaves. It is produced by the same eelworm, *Tylenchus devastatrix* (fig. 438, page 933), as causes clover sickness. Hence clover should never follow tulip-rooted oats, nor should oats follow stem-sick clover, upon the same land.



Fig. 442.—  
“Tulip-Rooted”  
Oat Plant.

RYE (*Secale cereale*, L.) is suited to thin dry soils, and is extensively grown in many of the German provinces, both as bread-corn, and for the purpose of distillation. It is there, also, very commonly given to post-horses, in the form of bread, for which purpose the rye is coarsely ground, and the bran not separated from the flour.

Of the common rye there are two hardy varieties—spring or white rye, and winter or black rye, the former of which may be sown from February to March, and the latter from the middle of September to the close of October. The quantity of seed per acre is from two bushels to two bushels and a half on poor, sandy, or dry limestone soils.

Rye may likewise be harrowed in with a thin crop of turnips, and both fed off with sheep. In the light chalk land districts of Wilts, Hants, and Dorset, it is very extensively grown as an autumn catch-crop to provide fodder for sheep, which are folded on it in the spring. Either for pasturing or for soiling, rye supplies an excellent article of food to sheep as well as to horses and cows; the first may be fed off with it in the spring, the two latter more towards the beginning of summer. The straw is useful for packing purposes, and has a special value in the “potteries.” It is also employed for finishing the ridges of thatched houses, as it is tougher than any other straw. It has lately been used at Enfield in the manufacture of a special slow-combustion powder.

BUCKWHEAT (*Polygonum Fagopyrum*, L.; nat. ord. Polygonaceæ) flourishes in dry, loose, and sandy soils, that are open to the effects of the sun; though the variety known by the name of Siberian buckwheat, which is much heavier and more palatable in the grain, will thrive in



the poorest soil, and is but little affected by cold. The best, and indeed the proper, season for sowing it is towards the end of May, or the commencement of June; and, in the course of a week, it generally appears above ground. The quantity is from one to three bushels per acre, if sown broad-cast, as it generally is, on account of the convenience of cutting it. The so-called "seed" of buckwheat is really the fruit,—a triangular nutlet. In July the crop begins to flower, and it is usually fit for the scythe about the beginning of October. Three or four quarters per acre is a fair crop. Buckwheat requires little or no manure, and affords an excellent food, either for soiling or for winter store. Occasionally, sheep are folded upon the crop when in flower. Given to horses employed in slow draught, in conjunction with bran or chaff, it will get them into fine condition, but it is sometimes apt to produce swelled legs and cutaneous eruptions; if given in a green state to cows it is said to increase the quantity of milk. It has been used for fattening poultry and swine; but the last-mentioned animals should not be permitted to feed entirely upon it, or they will be liable to be covered with scabby eruptions. The peculiarly fine flavour of the poultry in the South of France is said to be derived from this grain; but its fattening properties are not equal to those of the corn in common use. It is also good for pigeons, and is the favourite food of pheasants, whether wild or tame.

PEAS (*Pisum sativum*, L.; nat. ord. Leguminosæ) are amongst the most valuable of the farm-crops, but, owing to the uncertainty of the crop, their cultivation does not increase, especially since feeding-cakes have become so cheap.

There are almost innumerable varieties and selections, but those most commonly grown in field-culture are the Common Grey, the Maple, the Early Maple, the Partridge, and the Early Dun. Prussian Blues and many varieties of White Peas are also employed, though they were originally brought out as garden peas. In some districts, soft or wrinkled peas are largely grown for culinary purposes. Amongst them may be mentioned the Ne Plus Ultra, Telegraph, Champion, Yorkshire Hero, British Queen, and many others.

The chief distinction between a field pea and a garden pea is the colour of the blossom, which, except for the recent introduction of some of the latter kinds mentioned, is white in the garden pea, and blue and pink in the field pea.

The place of peas in the four-course system is after barley, and they are taken on light land as a means of resting it from clover, which causes clover sickness if grown too frequently. Peas are essentially a light land crop. The cultivation is very simple, as the barley stubble merely requires ploughing and dunging in the autumn or early winter, and scuffling, drag-harrowing, and harrowing down to a fairly fine tilth in the spring, a stale furrow being favourable to their growth. From  $2\frac{1}{2}$  to 3 bushels of seed peas are required per acre, and the rows are generally made from 10 to 15 inches apart; but the garden sorts for picking are best where drilled in rows 2 feet apart. They

are occasionally sown in autumn, but the greater part of the field peas are sown in early spring. February is the best month, though the season may continue until the end of March. The last-named is a good month for some of the White sorts, but the more tender wrinkled varieties should not be put in before the beginning of April, unless very early picking is desired. In choosing a variety, the nature of the land has to be considered, and a good guide is to take a long-strawed variety on weedy ground, and a short-strawed kind on clean ground. They should be cut by means of a pea-hook with a long handle, and not by the scythe, which cuts off and opens too many pods, thereby causing great loss of corn. When they are being hooked it is convenient to leave them in heaps or wads, as they are more easily dealt with subsequently. They require frequent turnings, as they are very succulent, and have great capacity for retaining moisture. They should be very dry before being stacked, especially in the case of the soft varieties.

Peas are chiefly used in fattening swine and sheep, and are better adapted for this purpose than beans. They should first be ground into meal for pigs, and split for sheep. When bruised and given to cows, in conjunction with other succulent meal, they give a flush of milk; pea-meal stirred in milk may likewise be given to calves with advantage. The haulm, if carefully gathered in a favourable season, affords a wholesome and valuable fodder for neat cattle, and is particularly relished by sheep; it is also usefully given, as rack-meat, to farm-horses, but it should always be chopped. It has, moreover, a special value for cows, as it produces the best-coloured winter butter.

**BEANS.**—The only kind of bean usually cultivated for feeding domesticated animals is the Horse-bean (*Faba vulgaris*, L.; nat. ord. Leguminosæ), of which there are several varieties: the large ticks or negro beans, the small ticks, and the common sort. The horse-bean is taller than the tick-bean, but it is not so full of pods. They will all grow under the same system of culture, only requiring more or less room, according to their height. Beans are more hardy than peas, and also a more certain crop; but they require a stronger soil, well manured. The best soils for the field bean are, generally speaking, the stiffer kinds of clay and strong loams. It is an exhausting crop, but a cleansing one, and often precedes the corn crop. Beans are most commonly spoken of as winter or spring beans, to distinguish those which, being more hardy, are planted in the autumn, from the tender varieties, which cannot stand severe frosts, and are therefore planted in spring. Those sown before winter should be put in as soon after harvest as possible: those planted in spring should be the first of the corn crops sown after the beginning of the year. They should be sown in wide drills from 18 to 24 inches apart, to permit the full use of the horse-hoe and the hand-hoe. About 6 to 8 pecks of seed are required per acre. Dibbled beans are the most likely to succeed as they come up more regularly, but beans should never be broadcasted as they cannot then be horse-hoed, and it is essential that they should

be. Hoings should continue as long as the hoes can be kept going. The sun and air are more freely admitted among the beans when drilled; and as they do not grow so tall as when close planted, they blossom and produce pods almost down to the ground, whereas the tall close beans produce them only near the tops of the stalks. It is not uncommon in some of the well-cultivated districts of the North, to drill beans with a small admixture of peas.

When the bean is intended for seed, it should be suffered to ripen thoroughly, but not to become over ripe; the skin should have acquired a yellowish leather-like appearance. Beans are cut with either the fagging-hook, scythe, or reaping machine, but where the straw is short, and the pods have formed very near to the ground, they are best pulled. The average crop is uncertain, perhaps not more than from 25 to 35 bushels per acre, even under the most favourable circumstances. The bean-plant is subject to rust and mildew. It also falls a prey to the bean aphid (known likewise as "collier," "black fly," "black dolphin"), which frequently smothers the plant, from the top downwards. The remedy is to cut off the top of the plant as gently as possible with a sharp knife, and burn it; when, however, a field is badly attacked, this is impracticable.

Beans are highly valued in stables, but ought always to be ground or crushed before being given to horses. Bean-straw, when properly harvested, and mixed with pea-straw, is considered to afford almost as much nutriment as hay of ordinary quality.

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## CHAPTER IV.

### ON THE "ROOT-CROPS" BEST ADAPTED FOR ANIMAL FOOD.

THE root-crop is the mainstay in the winter feeding of sheep and cattle, and its growth is therefore of the greatest importance to the grazier and flockmaster. The "root-crop" is chiefly made up of the different varieties of turnips, cabbages, and mangel, though in some districts carrots and parsnips are grown to a considerable extent.

TURNIPS (*Brassica rapa*, L.; nat. ord. Cruciferæ).—The SWEDE, or SWEDISH TURNIP, is by far the best variety of the turnip family, as it is hardier and more nutritious than the common kinds. It may always be distinguished from other turnips by the solid neck, which is not present in these, excepting in Laing's swede (compare figs. 443 and 444). Although the neck is a distinctive feature, it is one of the signs of quality, and the object of selection is to prevent its developing more than possible. The swede is in reality a specially selected and

cultivated form of the smooth-leaved summer rape, and if it is grown on unfavourable land, the root will return to its pristine type. A striking instance of this was brought under our notice a few years since, when one of the largest seed-firms sent us some specimens which had in a very short time reverted to rape. The seed had been tested at Kew, and verified as a distinct variety, and it had been sent to customers with all confidence. In every instance but the one under notice it had answered expectations, but in this case there was scarcely any development of "bulb" in the root, which grew in the hard and fibrous form characteristic of rape, while the neck ran up straight to the height of 18 inches or more, and threw out leaves in the same manner as rape; in fact, to all appearance, the plant was



Fig. 443.—Purple-Top Swede.

rape. The case, therefore, was one of reversion. It transpired that the ground on which this crop was grown was of a harsh moory nature, deficient in lime and other mineral constituents necessary to the development of the root, whilst there was present other mineral matter prejudicial to it. At the same time there was a considerable, if not excessive, quantity of nitrogenous matter in the land. This shows that the land must be in a favourable condition for the proper development of the root, whilst common practice proves that good cultivation and judicious manuring are requisite for the growth of satisfactory crops. The preparation of the land is therefore an important matter, and all the operations connected with it demand skill and judgment.

The swede is never grown as a catch-crop, but takes a premier position among rotation crops. A whole year is given up to the preparation of the land and the growth of the plant, with the one exception of the instance where it follows a previous root-crop, as is sometimes the case on the light chalk soils of the south-western counties of Eng-

land. In most rotations it follows the wheat crop, and is itself a fallow or cleaning crop, the main cleaning operations of the rotation being carried out during the time the land is being prepared for sowing it. The land should be broken up as early as possible after harvest, and if a thorough autumn tilling can be managed it will prove of great gain in the spring, when there is always a rush of work. If ploughed in the autumn the land should be untouched during winter, and it is generally not convenient to do anything but manure it until after the spring corn crops are sown. The dung should be put on in a partly fermented condition as early as convenient, special advantage being taken of frost, to avoid the injury which is done by carting on land when it is moist and soft. When an opportunity offers, the land should be ploughed

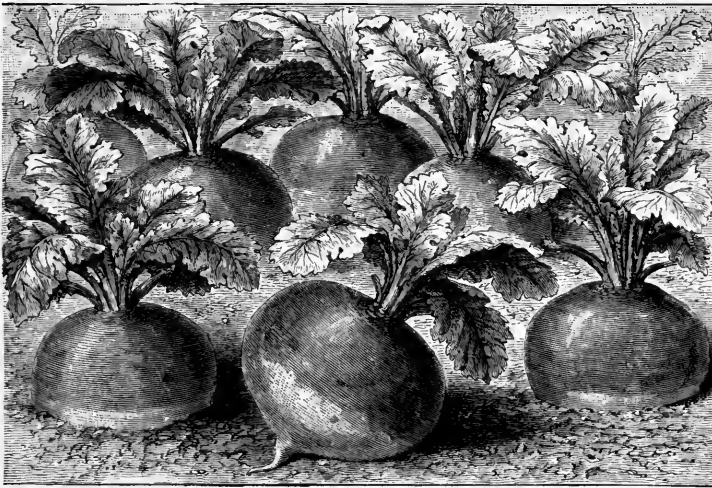


Fig. 444.—Purple-Top Turnip.

a second time, and then worked with stirring implements to get rid of couch and thistles, and at the same time to produce that disintegration of the soil resulting in tilth. A good mellow tilth is essential to the crop, and the endeavour must be to reduce the soil to a fine condition without allowing the small particles to become harsh or "nubbly." When the land is clean, and in a fit condition for seeding, it will generally be found advisable to put in a dressing of superphosphate of lime. When no farmyard manure is available, nitrate of soda and sulphate or muriate of potash should also be applied.

There are two methods of drilling in the manure with the seed,—by the dry ash drill, and by the liquid manure drill, descriptions of which will be found in the Implement section (Book the Eighth). The method described is known as drilling on the "flat," and this is most commonly practised on light soils in dry climates. The other system is known as drilling on the ridge or bout, and is practised on heavy soils, or in districts where there is a large annual rainfall, the raised

ridges being favourable for freeing the soil immediately round the plants from superabundant moisture. When roots are drilled on the ridge the early operations are similar to those practised on the flat, except that, instead of putting on the dung in winter, it is not applied till just previously to laying up the lands in the final ridges. The tilth having been sufficiently prepared, the land is laid up in ridges, and the dung is spread in the spaces between them, and then the bouting plough is run up the middle of the already formed ridges and splits them back so that the dung is covered in. While covering in the dung fresh ridges are formed above it, and it is on the tops of these that the seed is sown. The seed may be drilled in with superphosphate or not as desired. About 2 or 3 lb. of seed, and from 2 to 6 cwt. of superphosphate, generally constitute a suitable seeding and phosphatic manuring. While the plant is coming up it is liable to attacks of the Turnip-fly, which harass it until the rough leaves appear, after which it is safe. An immense amount of damage is done by the fly, the crop occasionally being destroyed as often as three times, thereby necessitating fresh tilling and seeding, with a consequent heavy outlay. Various methods have been devised to baffle these attacks, but few of them have been found effectual, though a crop is sometimes saved by dusting the young plant with lime or soot when the dew is on them.

When the plants have attained a width of three or four inches they require thinning, though they should already have been horse-hoed, and if the land is very wet, or the season has been cold, so that the early growth has been slow, they should also have been flat-hoed by hand alongside the rows. Horse-hoeing should be continued as long as the horses can walk between the rows without injuring the plants. The plants require seconding or singling a few weeks after the first thinning, as it is undesirable to have more than one plant standing in one place. The distance the rows are set apart is from 16 in. to 2 ft. 6 in. when on the flat, and from 27 in. upwards on the ridge. The plants should be set out in the rows at spaces varying from 11 to 15 in., according to the width of the rows. When the plants have passed the stage in which they are injured by the fly, they are liable to attacks of the Turnip saw-fly, the caterpillar of which feeds upon the leaves. Slugs, wireworms, leather jackets (the grubs of daddy longlegs, or craneflies), and many other pests are also very destructive during the growth of the crop.

Swedes are likewise liable to mildew. This appears in drouthy seasons following periods when growth has been unusually rapid. Very early sown swedes are most liable to this attack, therefore, in some localities, especially on "burning" soils, such as the gravel-loams, it is not found expedient to sow the seed before the second week in June. In some districts where there is less chance of drought, or of burning during a drought, the seeding commences in the early part of May, and the best advice to those who go as strangers to farm in a new district is not to be guided by past experience, but to follow the custom of the locality. When there is danger of mildew a dressing of nitrate of soda

is useful, for it keeps the swedes in a robust and growing condition, and they are then able to resist the attack. The ground should be freely stirred to keep the soil round the roots in a moist condition. It is not an uncommon error to imagine that if the surface is stirred there is greater chance of loss of moisture; this is a mistake, for when the surface is worked the continuity of the capillarity is broken, so that the moisture does not escape below the point where the effect of the sun and wind is felt.

Swedes should not be fed until they are ripe, as they are less nutritious before maturity, and possess properties which prove irritating to the stomachs of animals. For this reason it is advisable to have some other variety of turnip, or cabbage, in readiness for feeding in the early part of autumn. The swede is essentially a winter food, and is at its best from the middle of November to the beginning of March. It is hardy, but, if ripe, it will not stand the severity of a more than ordinarily cold winter. Therefore, the earliest and ripest, at any rate, should be got up and stored before December. If they are required for sheep-feed they are best clamped in heaps a chain square apart on the land where they grew; and, if for cattle, taken to a convenient place and stored, either in a long clamp or a root-house. When clamped, the tops only should be cut off, and the heaps should be covered with a layer of straw, which when fairly compressed should be from three to six inches in thickness. This should be covered with a layer of earth from two to four inches thick, to keep the wet out. At first it is advisable to have an opening at the apex for ventilation, but, after the roots have been clamped a fortnight, this is best filled up, as wet is liable to run in, and wherever moisture goes frost follows in severe seasons. When the roots show signs of sprouting in the heaps in spring, the greater part of the covering of earth should be thrown off, or they will ferment and rot.

Swedes are of two kinds, the green-top and the purple-top. The latter is the more generally grown. There are an immense number of varieties in the market, but they are more or less "selections" of the same kind. In choosing a variety it is more important to obtain one which has been carefully "selected" recently, than to choose one of good name but which has been badly "selected" for some time. It is therefore preferable to buy the seed from good firms, who are known to be careful selectors, even though they charge rather more per pound than traders who make no attempt at selection.

The TURNIP, under which name is included all varieties of turnips except the swede, is a form of the rough-leaved summer rape, which has been cultivated in such way as to develop the root rather than the foliage. It is distinguishable from the swede because it possesses no neck, the leaves appearing to grow straight out of the root. None of these varieties possess either the hardiness or the feeding properties of the swede, and they are more often grown as catch-crops, or are taken on land when it would be too late in the season to grow swedes. They are very useful on light chalk soils, where perhaps they form the larger

portion of the root-crop. When soils deficient in lime are cropped too frequently with swedes the land becomes "turnip-sick," and cannot be relied upon to grow swedes, but unless the land is in very bad condition the common turnips can be taken, though they, too, are liable to the attacks which indicate turnip-sickness. These attacks are variously known as Club-root or Anbury, or Finger and toe. Club-root in turnips, cabbages, cauliflowers, rape, and other cruciferous crops is the name given to a malformation of the roots. When pulled, the main root is found to be much dwarfed, whilst the side roots are often swollen into spindle-shaped masses, presenting an appearance (fig 445) to which the name of finger-and-toe is appropriately applied. Lumps or nodules may also be seen upon the root. A crop thus affected ultimately perishes, owing to the decay of the roots. This disorder is associated with the presence of a slimy fungus, *Plasmodiophora*

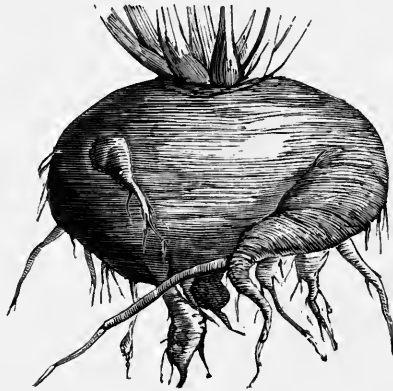


Fig. 445.—Turnip affected with "Finger and Toe."

Brassicæ. The spores of this organism are exceeding minute, and they not only attack and destroy cruciferous crops, but they infest the soil to so great an extent that it is unwise to grow such crops upon the same land again for several years. Liming or chalking the land is the best remedy

This disorder, by whatever name—club-root, finger-and-toe, or anbury—it may be called, must not be confused with a malformation of the root, which occasionally arises as the result of some peculiarity in soil, seed, or manure, and is really a case of "reversion" to the wild type. In such instances the growths though distorted are nevertheless healthy, but when the fungus is present, it is only necessary to cut across the root in order to see that it is filled with decaying matter. Nor, again, should the wart-like growths formed upon the root by the small beetle called the turnip-gall weevil be mistaken for the work of the fungus. By cutting across such galls on the roots of turnips and cabbages the legless maggots of the insect may be found.

The variety of different kinds of the common turnip adds to its use-



fulness. As in the case of swedes, there are many "selections" under different names. For early feeding it is usual to grow one or more of the White-fleshed varieties, such as the Purple-Top Mammoth, Pomeranian White Globe, and Lincolnshire Red Globe. Some of the Hybrids are also suitable for early use if sown at the beginning of June, particularly the Yellow Tankard and All the Year Round. For late autumn and winter feeding, the hardier kinds of White Turnip, such as the Imperial Green Globe and Hardy Green Round, are grown, together with the Hybrid varieties, of which the Purple-top and Green-top Aberdeens are perhaps the best known. An excellent new Yellow Turnip, called the Favourite, was introduced a few years ago. It was raised by crossing a Purple-top and a Green-top Hybrid, and is largely superseding the older sorts. The Stratton Green Round, the Grey-stone, and the Early Six-weeks are well adapted for growing after corn-crops, such as early peas, or others which have been harvested at the beginning of August; or for following a somewhat late bastard-fallow. The cultivation for these crops is very similar to that for swedes, the aim being to get a fine mellow tilth. The land is, however, more often prepared in early summer, as it frequently carries some other crop during the spring.

In calculating the quantity of stock which a crop may carry, the weight of the crop must be considered. If there is an average of 20 tons per acre, including swedes, kohlrabi, and mangel, it may be taken that an 8-stone sheep will eat 1 cwt. per week, with dry food in addition. A 12-stone sheep under the same conditions would require  $1\frac{1}{2}$  cwt.; and an old sheep, if allowed as much as it could eat, with a short allowance of dry food, would probably consume between 2 and 3 cwt. per week. On the basis of the 8-stone sheep, 400 sheep would eat an acre of roots in a week; therefore in a winter season on roots—which occupies about 36 weeks—36 acres would be required for 400 sheep. For a mixed flock the quantity required can be readily calculated from this. For cattle, with an allowance of  $\frac{1}{2}$  cwt. per day, an acre of roots weighing 20 tons would last 114 beasts a week; from which it may be calculated what acreage can be spared for the cattle.

Familiar as we now are with the turnip, its cultivation on a large scale as a field crop was commenced in comparatively modern times. Though we have records showing that turnips were in field cultivation at the beginning of last century, yet it was Charles, Viscount Townshend, of Rainham, Norfolk, who in 1730 first gave to them that status as a field crop which they had never before acquired. More than a century later, the "Quarterly Review," referring to this event, said: "A new source of agricultural wealth was discovered in turnips, which, as their important qualities became known, excited in many of their early cultivators much of the same sort of enthusiasm as they did in Lord Monboddo, who, on returning home from circuit, went to look at a field of them by candle-light. Turnips gradually replaced the old bare fallows, filled the cattle mangers with food in winter, and, when fed off on the light soils by sheep, consolidated while they manured them, and prepared the way for corn crops on wastes that had hitherto only

carried rabbits or geese." The introduction of turnips into our agricultural rotations is one of the most important improvements of recent times, the growth of the crop constituting an essential link not alone in the four-course, but in various other rotations.

The swollen root of the turnip or swede, like that of the mangel or beetroot, is really an artificial product, induced by special cultivation, in the absence of which these plants speedily revert to their wild condition. They are biennial plants, and the tumid root consists of an abnormal development of the reserve material stored up for the second year's growth of stem, flower, and seed. Though, as grown in rotation, roots are generally regarded as restorative crops, yet they depend for their successful development on the application of large quantities of manure. The value of roots grown in rotation is due, not alone to the opportunities they afford for cleaning the land, but also to the large amount of manure applied, to the considerable residue of this manure left in the soil for future crops, to the large amount of matter at once returned as manure in the leaves, to the large amount of food produced, and to the small amount of the most important mineral constituents of the roots which is retained by the animals consuming them, the rest returning as manure. The idea that root crops by means of their large leaves gained a large amount of nitrogen from the atmosphere was quite fallacious, for no crops are more dependent on a supply of available nitrogen within the soil; where a good crop of turnips is grown, by superphosphate of lime alone, it is a proof that the soil contained the necessary nitrogen. In a favourable season, indeed, few crops will lower the condition of land so effectually as turnips.

Experiments made at Rothamsted by Sir John Lawes and Dr. Gilbert have shown that swedes yield a far larger proportion of root to leaf than is the case with common turnips. Various kinds of manuring were tested, and, whilst with the highest nitrogenous manure there was, with an average crop of  $10\frac{1}{4}$  tons per acre of white turnip roots, nearly  $6\frac{1}{4}$  tons of leaves, there was, in the case of the swedes, with more than 12 tons of roots, not quite one ton of leaf. The result of the growth of the swede, therefore, is that almost the whole of the accumulation is in the food product, the root.

Other characteristic differences between the common turnip and the swede are worthy of note. Thus the swede gives, under the highest manuring, fully half as much again of dry substance per acre in the root—that is, half as much again food produced per acre—as the turnip. A quite insignificant amount of matter accumulates and remains, however, in the swede leaf, and the same assertion is true of the nitrogen and total mineral matter. It may, then, be asked why common turnips are ever grown, seeing that swedes possess so many advantages over them. The exigencies of soil, season, and farm economy supply the reasons. On the light soils of Norfolk, for example, which are very favourable to the development of root, and but little for that of leaf, and where the roots can be largely consumed by sheep on the land, without injury to its mechanical condition, the

swede is the predominant root. In the north-east and east of Scotland, on the other hand, several varieties of the yellow common turnips are grown in much larger proportion, and a large amount of leaf, serving as a protection against frost while the crop is still in the field, is not regarded as a disadvantage. It may be added that the higher the nitrogenous manuring, and the heavier the soil, the greater is the tendency to produce a large amount of leaf; and, moreover, the larger the amount of leaf remaining vigorous at the time the crop is taken up, the less fully ripe will be the roots, whilst, within limits, it is desirable, with regard to the storing qualities of the root, that it should not be too ripe.

In the Rothamsted experiments ten courses, extending over forty years, have been grown of swedes, occupying the first position in the familiar rotation of—roots, barley, clover (beans or fallow), wheat. The results fully confirm those independently established, to the effect that a very much larger proportion of the substance grown is accumulated in the root than in the leaf than is the case with common turnips. In fact, all the evidence goes to show that, whilst in the case of the common turnips a very large amount of the matter grown only serves for manure again, in that of the Swedish turnips a very small proportion of the produce is useless as food for stock.

Another plant closely allied to the turnip is RAPE, but in this case it is the foliage, and not the root, which is the object of cultivation. There are two kinds generally grown, the Dwarf and the Giant. The former is employed very extensively on the chalk soils, where it is often taken after a catch crop. The latter is more often grown on stronger land, and produces immense crops on rich fen soils, where it is taken as a main crop, as it occupies a full place in the rotation as the fallow-crop. They may thus be said to take the respective places of the turnip and the swede, and the cultivation is very similar. The seeding of the Dwarf variety commences as early as the end of March on the chalk soils, and, under these circumstances, it is fed off in August, and is allowed to grow up again to produce spring feed. The sowings continue until July, and are fed off in winter or spring as desired. The Giant is not sown in the Fens as a rule until June, and is fed off in September. It grows huge crops, which quite hide the sheep, and are equal to a 20-ton crop of swedes for the amount of food they produce. It is occasionally transplanted, but more often drilled. In the latter case it is either singled or not as may be preferred. The crop has a special value in producing green food for forward lambs, as when, in February and March, soft succulent food is scarce, this is in good condition for feeding off. It is a crop the cultivation of which is rarely imported into new districts, and the breadth sown does not increase. The late Mr. George Sheldon of Low Fields, a well-known progressive farmer, introduced it with marked benefit, as a seeding-down crop, to be fed-off by sheep in the autumn, on the Carboniferous Limestone soil of North Derbyshire; and it caused at the time, about the middle of the century, quite a revolution in the arable practices of the district.

The POTATO (*Solanum tuberosum*, L.; nat. ord. Solanaceæ).—Although, as a matter of convenience, included under the general term of “root crops,” it is necessary to remember that the potato of commerce is really an underground stem,—that swollen modification of the subterranean stem which botanists call a *tuber*. The “eyes” of the potato-tuber are leaf-buds, and, under suitable conditions, these begin to grow in the same way as the buds on a slip, or cutting, from an apple tree, or a geranium plant.

The dreaded potato disease, which first appeared about 1845, with most deplorable results in Ireland, is due to a fungus, *Peronospora infestans*, or *Phytophthora infestans*, the spores of which are capable of spreading from plant to plant with fatal rapidity, and of speedily reducing a healthy crop to a repulsive state of putrefaction. In dealing with this pest it is advisable to pay regard to the old adage, “Prevention is better than cure,” for it is well-nigh impossible to save a crop that is once smitten. The attack is spread by the germination of free spores upon the leaves of the potato plant, and it is to the destruction of these spores that measures should be directed. For this purpose the haulms should be sprayed with a mixture consisting of 6 lb. of quick lime and 6 lb. of sulphate of copper (blue vitriol, or bluestone) in 10 gallons of water. This is the *bowillie bordelaise* (“Bordeaux stirabout”) of French cultivators; it should be applied (see fig. 292) before the crop shows signs of attack, and repeated in close, humid weather which favours the development of the fungus.

For the following valuable details on the cultivation of the potato we are indebted to a grower of extensive practical experience, Mr. George Malden, formerly of Cardington, Bedford, though we have modified references to varieties to bring them up to date.

As in some years the production of potatoes is greatly in excess of the demand for the table, and large portions have to be used as food for live stock, no land should be planted with the crop that is not naturally adapted for its growth. This would at once exclude all heavy soils where the expenses are greater, and the yield and qualities worse than on light land; and, as potatoes are, or should be, a bulky crop, all land where the expenses of transit to a station or local market are high. Good drainage and cleanliness, particularly from willow weed and thistles, are essential, as is also a sufficient depth of soil to form a free tilth in which the rootlets can work and the tubers form.

Heavy dressings of manure should be applied in the autumn or early winter and ploughed in; if not manured at that time, manure that has been thrown up and heaped should be put on before planting in preference to raw manure, which has a tendency to cause potatoes to grow rank. The main object is to have the land in as light and loose a condition at the time of planting as is possible. Though dung must be the mainstay of the crop, top dressings of artificial manures are often advisable, and the great favour in which superphosphate of lime is held is shown by the large number of growers who use it to the extent of from 3 cwt. to 6 cwt. per acre: it should be applied very early in the

year so that it may become available for the crop the same season. Similar quantities of kainit are used, and should be put on the previous autumn, where the soil is deficient in potash, whilst soot is very popular, as, though the buyer pays heavily for the nitrogen, it has a beneficial effect on the soil and checks the ravages of slug and wire-worm. There need be no fear of overdoing the land as is the case with corn crops, and any extra dressing will be well repaid.

The three main systems of planting are the flat, the ridge, and the lazy bed. The lazy bed is not seen to any great extent in Great Britain, and is only adopted where—as in parts of Ireland—there is a heavy annual rainfall, and an excessive amount of moisture in the soil. It is far more expensive than the other systems, as the labour is chiefly manual. It consists in marking out beds from  $3\frac{1}{2}$  to 6 feet wide by trenches that are dug between them from  $1\frac{1}{2}$  to 2 feet wide. The potatoes are then planted on the beds, the soil from the trenches being thrown over them to cover the sets, and, instead of moulding them up, the trenches are dug deeper and the soil is continually thrown over the beds. The two popular methods are the flat and the ridge. The earlier preparation for each of these systems is similar, the object being to form a fine, deep tilth, though in the case of the ridge the manure is not applied till just previous to planting, when it is spread along the bottom of the trench made by a double-breasted or ridging plough. The potatoes are then placed on the dung, and the same plough is again used to split back the previously formed ridge, so as to cover both manure and potatoes to a considerable depth. As a general rule the sets are placed nearer together in this system than when planted on the flat, and a greater distance is left between the rows, the potatoes being usually planted 12 in. to 15 in. apart by 2 ft. 4 in. between the rows. The flat system permits of more variety, and there are four different methods,—placing in the furrow behind the plough, spading behind the plough, dibbling behind the plough, and spading in the drill row after a marker. The result of a considerable experience of all these methods is that under ordinary circumstances we have discarded all the other ways in favour of spading in behind a marker, as by that we find less hindrance, and have the sets in much straighter rows, so that we can horse-hoe much nearer without fear of disturbing them. Having prepared the land we mark out with a lightly-constructed marker, drawn by a couple of light nags, care being taken that they do not walk in the line which the drills are following. The drills are generally set 2 feet apart, a gang of men each with his potato-dropper, a woman—often his wife—or boy, follow down the rows in the order of a gang of mowers. The first man sets the distances, of course under our orders, by shovelling out a hole into which his dropper places a potato, the man following down the second row makes his holes at the same distances, emptying his spade into the hole made by his leader, thus covering the potato, and so on right down the gang. Spading behind the plough is done by a man walking down the furrow directly behind the plough and spading over in the line of the plough, a dropper following as under our plan; about six men spading will be required to two plough teams, the ploughs taking foot furrows

for which the American chilled digging ploughs are admirably adapted. Dibbling is done in exactly the same fashion, only with a dibble instead of a spade; and placing in the furrow, by pushing the potato into the lightly turned over soil in the furrow. In this case the horses have to walk outside the furrow, otherwise they would disturb the sets, and there is a certain amount of difficulty in keeping the sets the same depth in the ground. Besides they do not come up so uniformly, and, therefore, do not admit of hand-hoeing quite so early as under the other methods.

The planting of the main crop should be quite finished by the end of the third week in April; after that the plants have not time enough to crop heavily, and the late sorts will not mature soon enough to escape the danger of an early frost; the planting of earlier varieties should be finished by the end of the first week in that month. Among the very earliest varieties of potato, Myatt's Ashleaf stands conspicuous; but Royal Jersey Fluke, a greater yielder of inferior quality, is preferred in the Channel Islands, and Duke of York, as well as Ashleaf, is largely used in Cornwall, while Puritan and Epicure are grown extensively in Scotland. It is necessary, of course, that the operations should be such as to ensure the potato getting to an eating condition as early as possible, so that not only may the grower get a share of the fancy prices obtained by the foreigner for his early produce, but that the land may be cleared for the benefit of the second crop. In pursuance of this many growers sprout their potatoes, that is keep them in specially constructed shallow trays during winter, stored out of the reach of frosts, and when planting time comes these sets are carefully placed in the ground, great care being taken not to damage the sprouts. This has the effect of bringing the new potatoes into the market nearly a month earlier than from those treated in the ordinary fashion. With sprouted potatoes, early planting is not so necessary or advisable as with others. These latter are better planted as soon in February as the ground is in a fit state to make good work. As to the best distances at which to plant them, each grower has his own opinion, and the result is that great latitude is shown, though the most common distance is about a foot apart in rows from 20 to 24 inches apart; and, where it is intended to dig specially early or when a second crop of green stuff is to be transplanted, to plant them at the same distance in double rows about 6 inches apart, which are all moulded up together. Between these double rows a greater width of from  $2\frac{1}{2}$  to 3 feet is left for the moulding plough, the exact distance being so regulated that when carting the crop off the horses may walk down one pair of double rows and the wheels follow down the double row on either side—off which of course the potatoes have been dug—without injuring the green stuff transplanted down the moulding furrow. Among early varieties other than those named above, though not all, strictly speaking, "first-earlies," are Sharp's Victor, one of the earliest, Midlothian Early, Dalmeny Early, Sir John Llewellyn, Sutton's Ninety-fold, and Market Favourite.

Many new varieties of potatoes have been brought out in recent years, but more in second-early and late types, particularly the latter, than in first-earlies. The most successful second-early is still Findlay's British

Queen, now many years from its introduction. Other good varieties, new or old, are Royal Kidney, Dalmeny Radium, Beauty of Hebron, Early Rose, and Windsor Castle.

The number of new late varieties, at least so far as names show newness, is very large; but there has been much complaint of mere selections from old sorts being sent out under new names. None of them have proved equal in productiveness and quality combined to Findlay's Up-to-Date, which has been first-favourite as a main crop variety for many years. Northern Star, Eldorado, and a few other recent introductions, absurdly "boomed" a few years ago, have not justified the praises lavished upon them, though the former is one of the best disease-resisters. Factor and Duchess of Cornwall have proved great yielders, and King Edward VII. has done well on some soils, though its party colouring is somewhat against it for marketing. Maincrop, Langworthy, and Bruce have been extensively grown in Scotland; while the old Champion or Champion II. still has a good hold in Ireland, but not to the extent of earlier times; and Abundance, Magnum Bonum, Charles Fidler, and Colossal are grown in many parts of the kingdom. Most of these varieties are good yielders, Langworthy and Windsor Castle, however, being more notable for quality than for heavy cropping. Many others might be named; but we should be at a loss to name one equal in quality and flavour to the old Scotch Regent or Paterson's Victoria, now almost out of date—the latter entirely, so far as we can ascertain.

Since Mr. Malden contributed to this section, a great number of experiments upon potatoes have been carried out in different parts of the United Kingdom. Results have varied of course; but there has been a great preponderance of evidence in favour of the following conclusions:—

1. That when 20 tons or more of farmyard manure are used for potatoes, the yield may be increased by the addition of artificial manures, but not sufficiently, as a rule, to repay the additional expense.

2. That as great a yield can be obtained from 10 tons of farmyard manure and a moderate dressing of artificials as from double the quantity of the former alone, and at less expense, if the farmyard manure be valued at 5s. per ton spread on the land. The kinds and quantities of artificial manures with the half dressing of farmyard manure found most remunerative as a rule are 4 cwt. per acre of superphosphate and 1½ cwt. each of sulphate of ammonia and sulphate or muriate of potash.

3. That artificial manures alone will not often produce as much as the combination just named, though they may pay better where the farmyard or town manure has to be bought. The most successful dressing in this case consists of 4 cwt. of superphosphate, 2 cwt. of sulphate of ammonia, and 2 cwt. of sulphate or muriate of potash. A further application of 1½ cwt. of nitrate of soda as a top-dressing, just before the crop is moulded up, increases the yield, but not always remuneratively.

4. That whole seed tubers usually prove more productive than cut seed.

5. That large seed yields better than seed of ordinary size, but not sufficiently more to repay the extra expense of planting large tubers, as

the weight per acre of such large seed is much greater than that of seed of ordinary size.

6. That seed sprouted in boxes yields from a ton to two tons per acre more than unsprouted seed from the same lot kept in a clamp through the winter.

7. That Scotch or Irish seed produces in England much greater crops than English seed. Irish seed has only recently been tested against Scotch, and it has proved at least equal to it as a rule, and in some cases superior.

Thorough cultivation of the land is essential to success in potato growing, not only in preparation for the crop, but also after it has been planted. From the first it is absolutely necessary to keep the weeds in check, and frequent harrowings, so long as the land is not too wet or the sets moved, will pay. As soon as the potato-shoots are above ground it is time to commence hand-hoeing and horse-hoeing, and the more work of this sort, particularly single-row horse-hoeing, the better will the crop be; the benefits of heavy manuring, good seed, and even cleanliness of soil, will all be lost if the soil is not kept light so that air can get to the roots, and the few potatoes that are formed will be of bad shape.

It is not advisable to leave the moulding-up too late, as wet weather may set in and render it impossible to mould, as the deep tilth formed by the horse-hoes will not carry the horses till the haulm has grown so large as to seriously interfere with the operation, and many of the outside young potatoes will be rubbed off. The moulding or ridging should not be to a point at the top, but left some 6 to 8 inches across, not only to catch what may be a limited rainfall, but also to insure the potatoes having a good covering. If not, there will be many green-ended ones, and these being unfit for human food, are of no value save for cattle at about one-fourth of the price of marketable tubers. Through bad moulding or no moulding at all we have seen quite half a crop of the largest tubers spoilt in this manner, and not only that, but there is the serious risk of an early frost catching and completely spoiling them; therefore it is of primary importance that the moulding be well and carefully done, even though it has to be gone over twice. Potatoes planted on the ridge do not suffer to anything like the same extent as those on the flat; they are better covered in the first case, and the potatoes form deeper from the surface.

Potatoes required for storing are better left in the ground till thoroughly matured and, even if for immediate sale, look immensely better and invariably fetch higher prices than with their unripe skins all frayed and peeling. The two methods of raising the crop are forking, and ploughing out with a potato digging plough or other implement (see page 714). Before purchasing an implement with revolving prongs, it is desirable to be assured that it is not one that will bruise the tubers. Great efforts have been made to prevent this damage, and it is a question whether the best of the implements of the kind named injure the potatoes as much as men do when raising them by piecework with forks, as they naturally carry on the work with speed, and it is only by being very careful that the pricking of a good many



tubers can be avoided. Besides, in some of the chief potato-growing districts it would be impossible to obtain hand labour enough to raise the crop when the weather is suitable between the period of its maturing and the time when hard frost may occur to injure it. The ordinary potato plough can be made to do first-class work, especially when the back sifting bars are properly placed, but there is often too much room left between those directly behind in the line of the plough, and then the tubers fall through with the dirt and are covered up right in the bottom of the furrow, and these are never recovered like those that are easily harrowed out from the new ridge thrown up by the plough.

The crop is better carted off at once and pitted alongside a cartway or place with a hard bottom so that the carting from the pit may be practicable in soft weather; the tubers should be thickly strawed over in pits from  $3\frac{1}{2}$  to 5 feet wide, according to fancy, one spit deep and ridged up nicely to a point. The straw should be yealmed on and then a thick covering of earth placed over, nowhere less than 6 inches in depth; before winter a thick covering of any straw-like material should be placed all over the pit to make the potatoes thoroughly secure from damage by frost.

When putting up for market it is of great importance to make a good ware<sup>1</sup> sample; all the small ones that have not passed the sieve should be picked out, as well as all that are green-ended, diseased, damaged, or bad-shaped. These will invariably spoil the market to such an extent that the return for the truck load is as much without them in it as it is with their additional weight, and consequently they are simply being thrown away.<sup>2</sup>

MANGEL (*Beta vulgaris*, nat. ord. *Chenopodiaceæ*). This (figs. 446 to 448) is one of the most valuable of the root-crops, rivalling the swede in feeding properties, and exceeding it in keeping qualities; the latter render it the more useful, as the mangel takes the place of the swede when that begins to lose its best feeding character. Mangel is not adapted for feeding in the autumn, and though much is given to cattle in winter, it is undoubtedly best to hold it over for spring and summer consumption. In autumn the mangel is in an unripe condition, and the food contained in it is not in a form to be readily assimilated by animals. During winter the starch is gradually converted into sugar, the process continuing for some months. Mangel is fit to feed earlier when grown on light soils than on heavy soils. The produce is in the best condition for feeding from March to July, though it will not always keep so long.

The preparation of the land for mangel differs from that for swedes, as the seeding takes place somewhat earlier, and therefore under less favourable circumstances. This being the case, it is generally considered

<sup>1</sup> "Ware" is a term used among growers, and in the London markets, to denote all saleable tubers larger in size than seed potatoes. Tubers which will not pass through a riddle of  $1\frac{1}{4}$  in. or 2 in. mesh are usually regarded as ware; those which pass through such a sieve, but not through one of  $1\frac{1}{4}$  in. mesh, are seconds, or seed; and those which pass through the latter are "chats." Extremely large tubers are often picked out to sell to bakers, as they injure the sale of the ware.

<sup>2</sup> Mr Arthur W. Sutton, at various times, has written some excellent papers on the origin of the cultivated potato, the production of new varieties, and its cultivation, which have appeared in the *Journal of the Royal Agricultural Society* and other publications.

advisable to make special efforts in the autumn, so that the spring operations may be lightened, and rendered more easy. It is sound practice to select a piece of clean stubble land, and manure it with long dung. The land is ploughed during dry weather in the autumn, and left untouched until spring. If a clean piece of land cannot be found, that which is selected should be cleaned by horse labour, or, if not very foul, it should be hand-forked to get out the patches of couch. The winter frosts will make the soil friable, especially if the autumn ploughing has been done in dry weather, and in the spring it can readily be reduced to a tilth and sown. The seeding is similar to that for swedes, except that from 5 to 7 lb. of seed, according to the roughness of the land, are sown per acre. The seed requires very slight

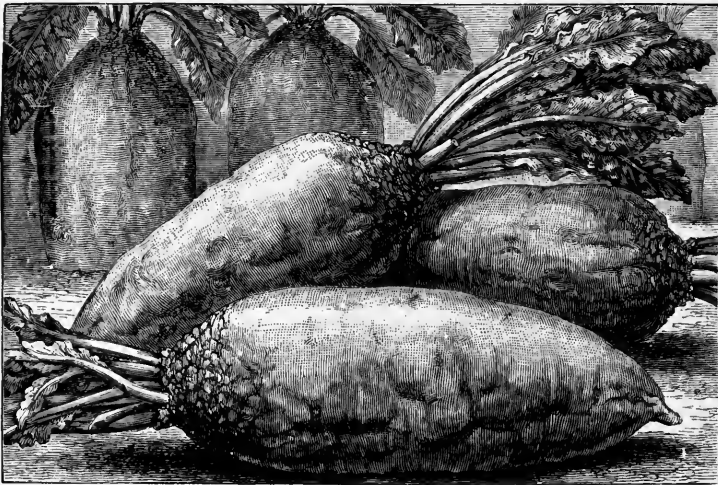


Fig. 446.—Long Red Mangel.

covering; if deeply buried it will not germinate. On land free from annual weeds, the seeding may be commenced at any time in April, but on land much troubled with weeds such as knot-grass or hog-weed (*Polygonum aviculare*), it is found inadvisable to put the seed in until the beginning of May. This is the more necessary since, if cold weather should follow the seeding, the mangel seed will not germinate, but the weeds will, and the latter eventually smother the mangel plants, so that it becomes impossible to set them out. Except for this danger, it is good practice to get the mangel in as early in the season as a good tilth can be prepared, after danger of severe frost has passed.

The mangel crop does not suffer from mildew to any serious extent; in fact, it is exceedingly rarely that the plant is attacked at all, unless it has received injury, in the form of bruises, or cuts with hoes. Mangel should be set out when small, as the plants are very hard to single when they are big, owing to a habit the roots have of intertwining. In some seasons, however, the grub of the mangel-fly is very

troublesome, and where this is the case it is wiser to leave them for a longer period, or the plant may be destroyed after it is set out. The habit of intertwining is due to the fact that the "seed" really consists of a husk containing more than one seed. Hence it is that samples of mangel seed are quoted as germinating over 100 per cent. In testing a sample, it is not the individual seeds that are taken, but the husks, each enveloping two or more seeds. For this reason a sample of "seed" cannot be relied upon unless it germinates well over 100 per cent., for unscrupulous dealers might put in one-third of sound seed germinating 3 seeds each, and mix with it two-thirds of useless seed; this would, and probably often does, cause a broken or uneven



Fig. 447.—Golden Tankard Mangel.

"plant" on the ground. The practice of filling up any gaps in the crop by transplanting into them the small-topped kohlrabi is strongly recommended. Mangel is a crop which comes up very unevenly, no matter how carefully it may be sown, and a full plant is rarely seen, so that there is naturally a loss on the unoccupied ground. It is the practice with many farmers to fill in the gaps with turnips or other roots, but it is doubtful whether anything is so well suited to the purpose as the small-topped kohlrabi. If the latter is sown in a seed-bed in March or April the plants are ready to pull when the mangel is set out, so that no time is lost. They will ripen at the same time as the mangel, and can either be stored or fed on the ground as desired. In districts where mangel-leaves are fed, the kohlrabi is extremely valuable, as it counteracts the ill effects which mangel-leaves often produce on the sheep which consume them.

When the mangel-plant has been thinned, and even before, the horse-hoe should be kept constantly at work to get rid of weeds, and to open the soil so that the rootlets may spread more easily. The

plants require seconding—that is, a second thinning—a few weeks after the first thinning, and may, if the land is very weedy, require flat-hoeing or hand-hoeing also. The land should be kept stirred as long as it is possible to work the hoes conveniently.

The mangel crop is not raised for consumption as a standing crop upon the ground, as is the case with most of the turnips. On the other hand, as the mangel is very susceptible to frost, it must be placed in safety before there is risk of injury from this cause. The most convenient method at the time is to pit or clamp the mangel in heaps on the ground whereon the crop grew; though this procedure causes much trouble afterwards, and is probably a source of injury to

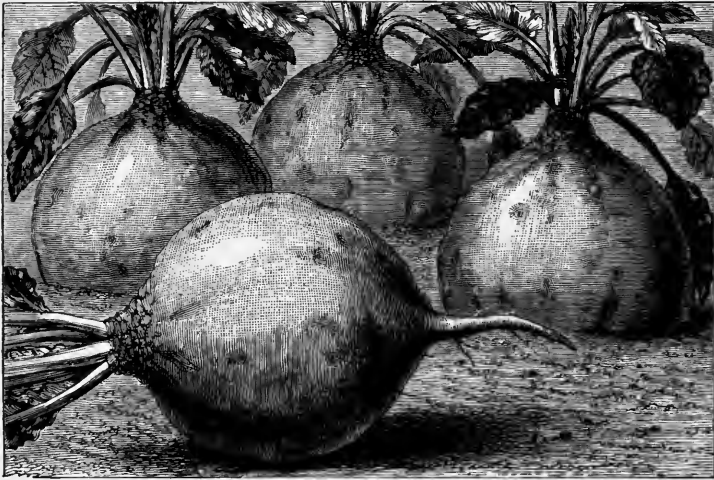


Fig. 448.—Yellow Globe Mangel.

the land by carting on it later in the season. Hence it is in reality best, under most circumstances, to cart the crop away immediately the roots are pulled. October is the usual month for harvesting mangel, and our climate is such that it is found to be unsafe to leave the crop in the ground after the first week in November. The roots should not be allowed to become too ripe before being pulled, for they do not keep so long as if they are pulled slightly unripe. As a rule, when the lower leaves drop and turn yellow, it is time for the crop to be taken up. Whether stored in small clamps in the open, or in long clamps near the homestead, the roots must be covered with a coating of straw several inches thick, upon which there must be a layer of earth two or more inches thick. In some districts an additional covering is given in the form of straw thatch, and wherever the situation is much exposed this is a commendable practice. Land rarely becomes mangel-sick, provided it is liberally manured, and on grazing farms where arable land is scarce it is not uncommon to set apart a piece of land entirely for mangel growing. This is the more to be recom-

mended where the arable land is very heavy, as the constant tilling and manuring make the soil more friable. Moreover, the crop is off in time for the land to be ploughed up before winter, so that it may receive the full advantage of frosts, and thus be made into a good tilth for seeding.

Although properly included amongst the "root-crops" of the farmer, it is necessary to remember that mangel is a plant far removed in affinity from the turnip and its allies. Turnips and swedes belong not only to the same natural order, Cruciferae, but to the same genus, and are, therefore, very closely allied to each other. But the mangel belongs to the far-removed order Chenopodiaceae, familiar to us in such a common weed as the white goosefoot, or such a well-known vegetable as spinach. The feeding-beet or mangel wurzel, and the many varieties of sugar-beet, all belong to one species, *Beta vulgaris*, of this order, and the beetroot as grown by gardeners in this country is as much a garden mangel as the farmer's mangel is a field beet.

In the Rothamsted experiments on the continuous growth of mangel

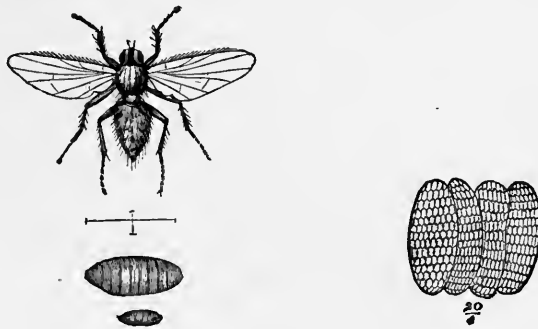


Fig. 449.—Mangel or Beet Fly (*Anthomyia betæ*).

Female fly; lines showing natural spread of wings. Pupa, natural size and magnified. Eggs, magnified.

upon the same land for eight consecutive years, commencing 1876, the yield of roots of mangel, where nitrogenous manures were applied, was much greater than that of either turnips or swedes, and there was also much more leaf. Speaking generally, there was about twice as much produce of roots per acre as of swedes with the same manures on the same plots, and the quantity of leaf was more than twice as great. It will not be forgotten that mangel seed is sown earlier, and the plant has a longer period of growth; it has a much more deeply-penetrating tap root, throws out a less proportion of its feeding roots near the surface, and exposes a comparatively large area of leaf to the atmosphere. With its more extended root-range it is less dependent on continuity of rain when growth is once well established—a fact well exemplified in hot summers, and it thrives under a higher temperature than the turnip. Hence the midland, eastern, and southern divisions of the country are much more suitable for the crop than the north-west

or north of England, or than Scotland, where it is comparatively little grown, though, where soil and climate are suitable, very much larger crops can be grown than of turnips, provided very heavy dressings of farmyard manure are employed.

The chief insect enemy of the mangel crop is the mangel or beet fly, *Anthomyia betæ*, a two-winged fly (fig. 449), the maggot of which blisters the leaf by feeding within its tissues. A dressing of 2 cwt. of nitrate of soda per acre has been found useful as a remedy.<sup>1</sup>

**CABBAGE** (*Brassica oleracea*, L., nat. ord., Cruciferae).—The **CABBAGE FAMILY** is quite as important as the turnip family, and belongs similarly to the useful order of the Cruciferae. Though farmers have been slow to appreciate the crop, yet cabbage-culture is undoubtedly extending. The several kinds in cultivation may be classified under four heads:—

(1) Those which grow with a long upright stem and do not form a "heart," the leaves or sprouts being the portion developed, as in the Thousand-headed Kale.

(2) Those which form a compact head by the infolding of the leaves, as in the Common Cabbage.

(3) Those in which the stem is developed so as to form what looks like a "root" above ground, as the Kohl-rabi, which was once commonly spoken of as the Turnip-rooted Cabbage.

(4) Those in which the stem divides and forms a corymbose head of imperfect flowers, as the Cauliflower and Broccoli, which are grown more in market-garden farming than on ordinary stock farms.

The increasing attention which is being given to the cultivation of cabbages in the place of turnips demands a few remarks here. The chief disadvantage of cabbage and kale is that they require to occupy the land longer than turnips; and for this reason, where the Norfolk system is rigidly enforced, it is difficult to grow maximum crops of all of them. But since landlords have become less stringent, farmers are able to adapt their systems to meet their own ideas, and one of these is to so arrange their cropping that more cabbages may be grown. Another reason that rendered cabbages unpopular was that they were thought to "draw" the land. They certainly do not allow any available manure to be wasted while they are on the ground, for they are greedy feeders, and are capable of making use of almost any amount of manure without becoming diseased, as is so often the case with corn crops. As, however, the crop is usually fed back to the land, there is no reason why there should be undue exhaustion. The idea probably originated from observations made in the spring, and the results of those observations have been applied to the crop throughout the year. If cabbages are fed off in summer or autumn, and the stems are allowed to sprout again, they will make vigorous growth in the spring, and will utilise any available manure. If the feeding off is delayed until such time as the land is required for seeding with spring corn, then the land will be in a temporarily impoverished condition, as the

<sup>1</sup> A paper on "The Early Feeding of Mangels to Stock," by Dr. J. Augustus Voelcker, appeared in the *Journal of the Royal Agricultural Society*, 3rd series, vol. x., 1899, p. 559.

cabbages will have seized that which, under other conditions, would have been the manure available for the spring-sown crop. But the exhaustion is of a very temporary nature, and there is no reason to suppose that the land really suffers more after cabbage than after turnips. Indeed, having farmed land where both turnips and cabbages have been freely grown for many years, we are quite prepared to state that there is actually no reason for such a conclusion. But, as the cabbage-crop, when left over in this manner, does retard the growth of the succeeding crop, any sprouts should be fed off before the middle of March. If this is done, and the crop is not taken off the land, there will be little sign of exhaustion from cabbage-growing.

The extra cost of growing cabbages beyond that of growing turnips has often been urged as an objection, but this too appears to be a matter of misapprehension, for though the cost of dibbling rather exceeds that of setting out once over, and the cost of the plants is greater than that of the seed, the subsequent cost of hoeings, and getting-up or feeding-off of the crop, is lighter. The great advantage of cabbages as compared with turnips is, that they afford a better opportunity of cleaning the land previously to cropping it, an additional month of summer weather being available for that purpose. While urging the supremacy of the cabbage crop, we do not wish it to be understood that we are advocating the growth of all cabbages and no turnips, for we believe that the best results are obtained when a fair division is made—the proportion of cabbages being greatest when the soil is inclined to be heavy, and of turnips when the soil is light. All cabbages, including Kohl-rabi, are better for being transplanted, and in this they differ from the turnip; they have hard woody roots, while turnips are soft and succulent and readily wither. If cabbages are transplanted they form bunches of small fibrous roots near the surface, and they are thus able to take up the plant food, which, as a rule, lies nearest to the top of the soil. When the main root is not broken there is a greater formation of root lower down and less at the top, and the plant does not grow so fast.

As cabbages are better for being transplanted, the following remarks on the formation of the plant seed-bed may be useful. Seed-beds are sown at two seasons—spring and autumn. The plants from the spring sown beds are required for transplanting throughout summer, and are sown in March or April. The autumn-sown beds should be seeded quite at the beginning of autumn; in fact there is no better time than during the second week of August. If they are sown sooner they are liable to form hearts, and if sown later they may not grow big enough by the time they are required. In choosing a piece of land for the purpose, that which is liable to turnip-sickness, or is of a weedy nature, should be avoided. It is best to select a light soil, as the plants can then be pulled with less injury than from heavy soil, which has a tendency to settle down firmly as time progresses. The bed should be sheltered from cold winds, and it is advisable to locate it if possible in some place where people are constantly passing by, such as a headland near a cart-road, a footpath, or a railway, so that birds, such

as larks and wood-pigeons, which do much injury to the plant in cold weather, may be constantly disturbed. It is better that a spring-sown bed should be well manured than that an autumn seed-bed should be rich, for it is generally desired to get the plants well and quickly grown for summer transplanting. On the other hand, it is more desirable that the autumn-grown plants should be sturdy, as they are better able to withstand frost.

The tillages should be shallow, not exceeding 3 or 4 inches, or, instead of growing thick fibrous roots near the surface, the plants will develop long main roots deficient in laterals, and what few side-roots there are will probably be broken off when the plant is drawn out of the soil, thereby tending to hinder the "striking" of the plant when re-set. To induce the growth of root-fibres a dressing of super-phosphate at the rate of 5 cwt. or more per acre, applied to the land immediately after the last ploughing, so that it may be harrowed in during the subsequent workings, is very useful. If this is done, the plants may be pulled at times when, owing to the dryness of the ground, it would be impossible to pull them under other conditions of growth. The mass of rootlets will carry away a small quantity of super-phosphate which will help to start the plant when in its new bed. By putting the seed into poor land an opportunity is afforded for applying soot if desired. Soot is very useful on seed-beds in winter for keeping off hares, birds, and slugs, and it is advisable to dress the winter beds with it at all times. If, however, the land is rich, the addition of a heavy dressing of soot, which is a nitrogenous manure, will probably cause the plants to grow too fast, and they will become "leggy." The surface of the seed-bed should be worked down as finely as possible, and the seed may either be drilled or sown broadcast. The best-shaped plants are grown from seed which has been sown broadcast, as the plants stand more evenly about the ground than when drilled, for in the latter case they are apt to draw up and grow leggy; still, there is an advantage gained by drilling, for it is then possible to hoe out the weeds, which cannot be done where the crop is sown broadcast. In drilling, the rows should be from 5 to 8 inches apart.

It is roughly calculated that 1 lb. of seed produces enough plants or an acre when transplanted; but, as 6,000 plants are sufficient for an acre of pickling cabbages, and 40,000 are required for the varieties grown for producing the small cabbages known as "collards," whilst 60,000 plants are sometimes planted when setting out turnips for producing crops of turnip-seed, this is only an approximate estimate. However, as a rule, from 10,000 to 14,000 cabbage plants are usually put upon an acre, and 1 lb. of seed may be relied upon to produce these, and from 10 to 12 lb. of seed is a fair average quantity to sow per acre. The seed should be lightly harrowed or raked in, and covered with about  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch of soil. It may be desirable to roll the land after seeding, but this must be decided in each case according to the condition of the surface. It is more economical to grow plants than to buy them.



The CABBAGE.—There are many kinds of the hearting cabbage, and there are almost innumerable “selections” of each kind. It is convenient to subdivide the hearting cabbages into five sections, embracing respectively—the Imperial type, the Enfield Market type, the Drum-head type, the Tom Thumb type, and the Pickling or Red Cabbage. Those of the Imperial type come to maturity earliest amongst the field cabbages, and should be planted out in autumn or early spring, so as to be fit for feeding in June or July. The plants may be set about 18 inches by 24 inches apart. Those of the Enfield Market type may be set out 2 feet square apart, and should be planted out at the same time, in order to be fit for feeding when the Imperial are finished. But as there is considerable risk to be run on account of slugs, birds, hares, and frost it is not wise to set out too many in the autumn, for they are much more difficult to protect when spread over a large field than when contained in a small seed-bed. Soot is the best application as a protective against the three first-mentioned enemies; and by placing the bed in a protected situation under a hedge to shelter the plants from the North, they will be rendered fairly secure from frost.

The Drumhead, or Cattle cabbage, is a very heavy-cropping late variety, which follows the Enfield, and is not, as a rule, fit for feeding until September, lasting until Christmas. It should be transplanted from February for producing food in September, and may be transplanted as late as May for producing food for the latter part of autumn and the winter. As these grow to considerable size they require more space, and on rich land 3 feet square is not too much to allow. There are nine distinct kinds of the Drumhead recognised in the trade. The Tom Thumbs are grown to produce very small heads which are sold under the name of Collards, and are essentially market garden produce. They are planted out from 12 inches square to 15 inches square, and often follow crops of peas, or onions, taken off the land very early in the summer. The Pickling Cabbage is a very heavy cropper, and requires as much space as the common Drumhead. There are two kinds, known as the Oxheart Pickler, and the Drumhead Pickler. The former is best for pickling, as it is darker in colour. During the past few years the pickling trade has chiefly been supplied from Holland and Belgium, so that the demand for those grown in England has been small; but, as no cabbages afford better sheep-food, they deserve more attention from English flockmasters. Savoys are very hardy cabbages and will stand the coldest winters without injury.

When cabbages are transplanted in autumn or spring there will have been but little opportunity of preparing the land, hence the greater part of the tillages must be done after the crop is in. Cabbages should always be planted on the “square,” that is, so that the rows of plants run at right angles. This is secured by first marking out the rows in one direction by means of a drill, and then crossing these rows at right angles with the drill again. Where the coulter cross-cut are the places at which the plants should be inserted. It will then be convenient to horse-hoe the

crop in two directions, and a good tillage may be made over nearly the whole of the ground, only that immediately round the plant being missed, and this can be stirred and kept clean by the hand-hoe. It is doubtless an advantage to work the land previously to planting it, but in autumn and very early spring this is not always convenient, so it is usual under such circumstances to place the plants between the furrows, which is useful in that the furrows afford some protection against severe weather. The land should be highly manured for cabbages. It is, indeed, practically impossible to over-manure it, as cabbages do not suffer from mildew as corn crops do when over-dressed. They are greatly benefited by nitrogenous manures, and nitrate of soda is rarely applied with greater advantage than to cabbages. Common salt is also a cheap and effective manure, which may be sown in conjunction with the nitrate. Soot is likewise valuable as a manure, besides serving to check the attacks of insects and birds.

Cabbages may be fed with impunity at any age, which, as has already been mentioned, is not the case with swedes. All kinds of stock keep healthy and improve in condition when fed on them. They are superior to turnips of any kind for milking cows as they impart no unpleasant taste or odour to the milk or butter, unless the leaves are in a decaying condition; if in this state the outside leaves should be stripped off before the cabbages are given to cows. They are the safest of all foods given to farm stock. If, however, they should be infested (from August to October) with the aphis, or green fly, they are dangerous for young sheep as they cause scour. In such cases it is advisable, provided the hearts are solid, to strip away the outer leaves before feeding.

THOUSAND-HEADED KALE (fig. 450) is a good representative of the sprouting cabbage, and is the variety chiefly grown on the farm. But there are many other kinds more or less similar to it which are grown in market gardens, such as the Cottager's Kale, the Curly Kale, and Brussels Sprouts. It is generally supposed that the Thousand-headed kale is a crop of very recent introduction, but as it appears in seedsmen's catalogues at the beginning of the century this is not the case. It was, however, very little grown until 1876, when Mr. Robert Russell strongly advocated its claims to a permanent position in the list of farm crops. Mr. Russell had for some years been improving his stock and had established a very good "selection," and even now Russell's stock is considered to be the best.

The cultivation for thousand-headed kale is very similar to that for other kinds of cabbages, and the crop may be grown so as to furnish food for stock at all seasons. A mistake is often made in not allowing it to sprout sufficiently before it is stocked; the mass of green food which the plant provides is not attained until the sprouts form, and this is not until the plant has made its full stem-growth and thrown out lateral branches. We have frequently seen a crop spoiled by too early stocking, and the farmer has acquired a bad opinion of its

capabilities in comparison with other crops. It is in reality a very heavy cropper. The kale should be transplanted in the same manner as other cabbages, for there is a larger growth, and the land is not taken up by the crop for so long a time. It is not uncommon for it to be drilled and singled, but this course is not to be recommended. The plants may be transplanted at almost any season when the land is in fit condition for dibbling, but our experience has been against transplanting kale in August or December. May, June, or July are



Fig. 450.—Thousand-Headed Cabbage or Kale.

not bad months for the work, as the plant grows well, and will be big enough before winter to develop into a crop, but August-planted kale will only make a small crop in the spring, and instead of developing sprouts will run to seed and be of little feeding value. That put out in the autumn will not run to seed but will grow to great size in the summer; and that put out in spring will come in a little later. If kale is cut it may be allowed to grow up several times, but if sheep eat it off they are liable to gnaw the bark off the stem, and the subsequent crop is injured.

KOHL-RABI (fig. 451), is a very valuable plant of the cabbage family, and like all other cabbages may be eaten without risk of injury to the animal at any period of its growth. It requires a rich soil in order to attain its best development, and, like all cabbages, thrives most on strong loams. It, however, produces very heavy crops on the medium loams, provided the land has been well prepared; and when such soils become turnip-sick they may safely be taken for kohlrabi, which is very little susceptible to anbury, or finger and toe. Many farms would have been unable to carry the number of sheep which they have done if kohlrabi could not have been substituted for swedes or other turnips which often failed when sown. The seed should be sown on seed-beds in March or April, and the seedlings transplanted as soon as they and



Fig. 451.—Short-top Kohlrabi.

the land on which they are to be grown are fit. Of all plants of the cabbage type kohlrabi is the most successfully grown by being drilled and then set out like turnips. Notwithstanding this, many growers consider they gain six weeks by transplanting, as the crop matures so much earlier, and also grows to greater weight. Both bronze and green varieties of kohlrabi are known, but the green is almost exclusively grown. There are hardy or big-topped varieties, and small-topped kinds which come to quick maturity, but are not able to withstand the severity of winter, and are therefore only useful for autumn food; still they are of great value for feeding at this season. They are particularly suited for filling in gaps in the mangel crop at the time the mangel is set out, and for this reason alone a small seed-bed of kohlrabi should be available on every farm. The tops of the hardy variety are very delicious as table vegetables in January, when they have sprouted. Kohlrabi is a German term, literally meaning cabbage-turnip.

The Cauliflower and Broccoli are not grown on farms, except those on which market garden crops are taken. Neither are they cultivated for stock feeding. Their culture is similar to that of other cabbages, and they require very heavy manuring.

The CARROT (*Daucus Carota*, nat. ord. Umbelliferæ) is raised from seeds, which ought to be previously well rubbed in the hands, to divest them of their beards, and mixed with dry sand, ashes, bran, or powdered charcoal. The last-named is to be preferred, where it can be easily obtained. This mixing prevents the seeds from adhering to each other, or to the drill, and from coming up in patches. Carrots flourish best in light sandy loams, which should be well loosened by frequent deep ploughing, or subsoiling and harrowing, in order to enable the long tap-roots to penetrate to the necessary depth. They may, in fact, be grown on any loose soil, which is deeply and thoroughly cultivated; but on weedy soils there is much difficulty in keeping the crop clean, as in the early stages of growth the leaves are small, and it is very troublesome for workmen to distinguish between them and weeds.

Carrots are a most valuable food, and are relished by all animals, but are particularly valuable for milking-cows and horses.

The Belgian White carrot is of more rapid growth than the red variety, and therefore in unfavourable seasons answers better, but it has not come into very general use. It is equally acceptable to live stock. According to the late Mr. Philip Pusey, white carrots generally yield on an average eight or nine tons per acre more than red ones. Mr. Morton, of Chester Hill, found that a crop of white carrots sown on a deep sandy loam, without manure, yielded at the rate of 26 tons 3 cwt. per acre. Many feeders consider this crop equal to any of the roots usually given to cattle.

Carrots require careful cultivation, and should not be sown on foul land; clean wheat or barley stubbles are best for them. The sowing should take place at the end of April, or during the first or second week in May, and previous to this the land should have been prepared by a manuring of farm-yard dung ploughed in some five or six months before, and, subsequently to that, by deep ploughing, subsoiling, and harrowing, with intermediate rollings. The seed should be drilled, and not sown broad-cast, and the ground afterwards rolled. About three or four weeks later, the hoeing must commence. The carrots will be ready to take up about six months from the time of sowing, and should never be left in the ground later than November. A good soil, well cultivated, will yield from 16 to 20 tons per acre. The crop requires digging when the tops die down in the autumn, and it should be got up before there is risk of frost. Carrots are stored in the same manner as potatoes.

As carrots will grow without the assistance of manure, and as good crops have been thus obtained, an opinion at one time prevailed that the application of manure was injurious to them. It is true that raw manure, ploughed in shortly before the sowing, very frequently causes the

plant to become *forked*, and thus spoils its appearance for the market ; but manure which has been incorporated with the soil sufficiently long to have become decomposed, will always be found to increase the produce. Salt dug into the ground has been known to increase the crop one-half ; salt and soot is also a very beneficial manure for this crop. Rape-dust and bone-dust have been recommended.

Carrots form a palatable and nutritious food for almost every kind of stock. They may be given unboiled. Mixed with cut straw, there are few things that will better support the horse, and colts are brought into excellent condition when fed with them. To the cow they afford a wholesome food, and colour and flavour the butter much more agreeably than turnips. The pig eats them ravenously, and thrives upon them ; and if the veterinary surgeon were to state his opinion, it would be that the carrot is one of the most valuable medicines which he has at his command. In the form of poultice, it will give a healthy character to foul ulcers, and it will heal some of the varieties of "grease" where everything else fails. When colts, and young horses, too, are recovering from distemper, or catarrh, or strangles, or when it is doubtful what turn the disease will take, there is nothing so likely to recall the appetite and to turn the scale in favour of life. Carrots occasionally have a similar effect, although not so decided, upon cattle ; they are, indeed, invaluable in these respects. If the sick animal can be induced to eat them, good will in all probability result, and in no case will they do harm.

The carrot crop is subject to the attacks of various insects, some of which, as the aphides or plant-lice, attack the leaf, and others the root of the plant. The *rust* is one of the worst diseases to which this crop is liable ; the seat of the evil is here in the root, and the cause is a small maggot, the larva of the two-winged fly, *Psila rosæ*. A top-dressing of cow-dung, or pigeons' dung, or of sand saturated with spirits of tar, or quick-lime, spread over the ground immediately before the sowing, or drilled in with the seed, are the remedies prescribed for the rust ; washing the leaves with an emulsion of soft soap containing paraffin is a means of getting rid of the plant-lice.

The PARSNIP (*Pastinaca sativa*, L., nat. ord. Umbelliferae).—This root has hitherto been little used for the food of cattle in this country, although in some parts of France it is highly valued, and in Jersey and Guernsey it is cultivated upon an extensive scale. It gives a flavour and richness to the milk of cows which is scarcely exceeded by the carrot ; swine are fond of and readily fattened by it, and cattle relish it, and do well on it. Its cultivation is very similar to that of the carrot, and it can be grown on all deep turnip soils, and, with proper care, on heavy or light, wet or cold lands. It is so very hardy that it may be left in the land throughout winter without fear of injury from frost ; but when the crop is dug it should be clamped like carrots.

The JERUSALEM ARTICHOKE (*Helianthus tuberosus*, nat. ord. Com-

positæ).—This plant has been recommended as a substitute for, or at any rate as an auxiliary to, the potato crop. It is one of the hardiest roots we have, as well as one of the most productive; it will grow on almost any soil, in almost any situation, with little or no manure, and is comparatively free from disease. It is propagated much in the same way as potatoes, from “sets” or eyes. The great objection to it is the difficulty of getting rid of it from land in which it has once been sown. It is relished by all live stock, especially when cooked; for pig feeding it is particularly valuable, and for milch cows, it has a capital effect upon the flow of milk, and if—like turnips—given after, not *before* the milking, imparts no unpleasant flavour to the milk. Moreover the flavour, if any there be, is decidedly more pleasant than that of the Swedish turnip.

GREEN CROPS ALL THE YEAR ROUND.—This chapter may be appropriately closed by a few hints as to the providing of a succession of green food throughout the year, an excellent and practical idea which was first formulated by Messrs. Sutton & Sons, of Reading, to whom we are indebted for most of the illustrations in this chapter.

The interest in green crops varies with the character of the season. In burning summers, an abundant supply of nutritious green food is of almost priceless value where there are large flocks and herds. In dripping seasons the green crops are scarcely wanted. They may even be regarded as superfluous, and possibly worthless. But while we are able to forecast with so little accuracy the weather of to-morrow it is surely prudent to prepare for contingencies, and with a little foresight and management there need be no waste at all, for every load of green-stuff not wanted when ready may be treasured for future use by means of the Silo. In the strict sense Silage is not a green food, but it answers the purpose of green food when a fresh-cut crop is not available. Wet seasons afford opportunity for making stacks and filling silos. Burning summer days and periods of hard frost demonstrate the value of such a provision.

The *Hungarian Forage Grass* (*Bromus inermis*) derives peculiar value from its very early growth in spring, when a bite of green food is particularly valuable for folding sheep. The first crop may also be cut for soiling, and later, if necessary, it can be turned into summer silage.

*Cabbage* is the most important of all our green crops. It will grow on almost any soil, and endures extremes of heat and cold with comparative indifference. By the judicious choice of varieties, and by sowing at different periods of the year, it is not difficult to insure a continuous supply for almost the entire cycle of the seasons.

The value of *Grass and Clover* leys has yet to be fully understood and appreciated. Leys can be used for making hay, for grazing, for cutting as green food, and also for the production of silage. To obtain the benefit of the crop for the last-named purpose it is necessary to sow a mixture which should be adapted to remain down for three or four years. It may include Cocksfoot, Timothy, Tall Fescue, Perennial Rye Grass,

Hungarian Forage Grass, Lucerne, Alsike, and Giant Hybrid Cow Clover. All these are strong-growing plants, capable of producing great bulks for the scythe during the first few years after sowing, and they make silage of the finest quality.

*Italian Rye Grass* is so extensively grown, and its importance is so well understood, that here it need only be said that there are two seasons of sowing—spring and autumn. But we must protest against the custom of some graziers in allowing the plant to become too old before it is cut for hay or silage.

On poor land, where little else flourishes, *Kidney Vetch* (*Anthyllis vulneraria*, nat. ord. Leguminosæ) will supply a heavy crop suitable for hay or the silo.

*Lucerne* will not thrive on all soils, but in every case where it will grow a fair crop it is worth attention. It is a very deep-rooted perennial, and will stand for several years. The strength of the plant depends on the accessibility of lime, for which it will send down roots to an astonishing distance, and it then becomes practically independent of rain for a long period. It may be grown in the company of Tall Fescue, which is also a deep-rooted plant. The combined crop must be cut young, and will yield two or three cuttings of excellent quality in each season.

*Maize* and *Sorghum*—both members of the natural order Gramineæ—are properly denominated “Giant Forage Plants.” They develop rapidly, and they thrive most and are of the highest value in dry, burning seasons that put other green crops *hors de combat*. A plot of either or both of these plants is likely in a hot summer to prove of such service that it is well worth while to grow them regularly, although there may be no urgent need for them more than once in three or four years. It augments their value that they must be sown so late as June, by which time the fate of the early Turnips can be pretty accurately determined. Both plants make good silage, and can be utilised for this purpose in seasons when other crops yield a sufficiency of green food.

*Mustard and Rape* form part of the routine on most farms.

The demand for *Trifolium* or Crimson Clover, varies extremely with different seasons. It is a plant, however, that should never be overlooked, both on account of the economy of its culture, and for its great usefulness in early summer. An extra late variety, now cultivated, materially extends the time of cutting.

Root crops scarcely fall within the scope of the present subject. But there is an important application of the *Turnip* which is far too little practised, and which brings it within the category of green crops. By sowing late in August or early in September, and allowing the plants to stand thickly on the ground, there will, in spring, be an abundant growth of wholesome green food, admirably adapted for folding sheep. The plant requires no hoeing, and is therefore most economical as regards labour, and there need be little apprehension of injury by frost, for the plants will protect one another.



## CHAPTER V.

## ON THE QUALITIES AND COMPARATIVE VALUES OF FOODS FOR LIVE STOCK.

FOOD is the raw material from which animals build up and maintain their bodies. Even an adult animal not increasing in weight and doing no work, such as a "store" ox or "store" sheep,<sup>1</sup> consumes a certain daily allowance of food, without which it would rapidly become thin and die—in other words would starve. Food given in a proportion over and above that required for the mere maintenance of life and normal weight either goes to aid growth (in young animals), or to produce that increase in weight called "fattening" (in mature stock), or it is spent in producing work (as in horses and draught oxen). Food given in excess beyond the maximum which the animal can utilise for these purposes is simply undigested or (*quâ* food) is wasted.

One of the chief facts that occur to any one thinking for the first time about the properties of the animal body, as distinguished from vegetable organisms, is that animals have a high temperature. Animal life is at once associated in our minds with warmth, and coldness with death. That heat cannot be produced, or kept up, in an ordinary fire without the continual consumption of material (fuel) is familiar to us all, the heat of the fire being the result of the chemical process of combustion, which is merely rapid oxidation, that is to say rapid chemical combination between the wood or coal used as fuel and the oxygen which is the main active constituent of the air. The heat of the animal body is produced very similarly—by a process of combustion in which the air taken into the animal's lungs serves to combine through the medium of the blood with the products of digested food, burning them up and producing heat. The process is less rapid and less fierce than when coal is burnt in a fire, but ultimately the result is much the same, and in order to keep up this burning or oxidation process in the blood of the animal we must supply it with its necessary "fuel"—*i.e.* food. The animal body, like all other warm things, rapidly radiates or gives off its heat to the surrounding air, so that, in order to maintain its temperature the production of heat must be always going on. If the supply of fuel (food) is neglected, Nature still keeps up the heat for a while at the expense of certain reserve fuel (mainly fat) which the animal has stored up in its tissues, and when this becomes exhausted, even the muscular tissues themselves are gradually used up—the animal getting thinner and thinner (starving) until a point is reached at which the substance of the body has been so far used up that the various organs refuse to carry on their vital functions, and then the animal dies of starvation.

The combustion of food serves other purposes besides the mainten-

<sup>1</sup> A "store" animal is defined as one not yet put upon fattening food.

ance of animal heat. Just as we can utilise some part of the heat of burning coal to boil water and then, by means of the steam produced, to generate mechanical force (as in the steam-engine), so the animal body can use part of the heat generated by the oxidation of its food to produce mechanical force, whence arises all animal movement. The mechanical movements which take place in the involuntary act of respiration, in the beating of the heart, in the circulation of the blood, &c., are all derived from force generated by the utilisation or oxidation of materials derived from food. So also are the voluntary acts of walking, traction, &c., which we call work. In order therefore to maintain an animal at a given weight, we must supply it with sufficient food to keep up its temperature and to generate the force necessary for any work that it may have to perform. If our object is to fatten it—to get the greatest increase possible out of a given allowance of food—we endeavour to make the conditions such that as little of the food as possible is required for mere maintenance. Thus we find that an ox in a stall fattens faster than an ox in the pasture, because, as he does not walk about, he spends less of his food in the production of mechanical force. Furthermore, in the winter, an animal in a fairly warm and well-sheltered stall fattens more economically than in a cold and draughty shed, because he has to spend less of his food in producing heat to make up for the increased radiation which goes on in cold or draughty surroundings.

Summarising what has been said in the foregoing paragraphs, an animal must consume a minimum allowance of food per day in order that he may keep warm and move—that he may live and maintain his weight. Any further digested food (except when it is spent in work, as with the horse) goes to “fatten” the animal, and the rapidity of fattening depends, apart from the natural aptitude for fattening of the individual animal, upon the judgment of the feeder in selecting his foods, balancing their proportions, and regulating the quantity. Since, whether he fattens quickly or slowly, the daily quantity of *maintenance* food remains the same, as a sort of fixed charge, it is obviously to the interest of the farmer to decrease the length of the fattening period as far as possible. If he can get an animal ready for the butcher, by liberal feeding, thirty days earlier than by a less liberal or less judicious diet, he saves the daily cost of *maintaining* the animal for thirty days. This saving will generally speaking be far more than the extra expenditure upon the more liberal or better-proportioned diet that results in the earlier fattening.

It is in this consideration that we see the great advantage of *early maturity*, and of late years the attention of breeders has been largely directed to the selection and propagation of stock having the aptitude for growing and fattening rapidly; in other words stock that will, during their lives, consume less food for merely maintenance purposes. The skill and experience of the farmer is exercised in the selection of the best bred animals from this point of view, and in taking the fullest advantage of their power to fatten rapidly under a good regimen.

So far we have spoken of food in general terms. We have now to

consider of what materials, chemically speaking, food is made up, and what are the properties and functions of these materials. This we can only do briefly, referring the reader who is desirous of more complete and detailed information on the subject to treatises on agricultural chemistry.

The actual chemical ingredients necessary in food are carbon, hydrogen, oxygen, nitrogen, and mineral salts, for it is of these materials that the animal body is built up. Some of these however, may be combined in various ways, forming either nutritious substances, or substances devoid of feeding value. The substances on which the value of food depends are:—

- (i.) Albuminoids.
- (ii.) Fats.
- (iii.) Digestible carbohydrates (starch, sugar, &c.).
- (iv.) Mineral salts.

The three first named are, as regards quantity, the most important. Mineral salts are vitally necessary for animals, but in foods their proportion is quantitatively small compared with the first three classes of substances.

In addition to the substances just enumerated, foods contain other substances which are either devoid of actual feeding value—such as indigestible woody fibre or cellulose, and certain organic acids,—or which, like the nitrogenous substances known to the chemist as “amides,” have only a partial or inferior value as food constituents.

*Albuminoids*, are substances rich in nitrogen, as well as in carbon, hydrogen, and oxygen, and are well typified by the albumin which constitutes the white of eggs and by the gluten of wheat. They are analogous to the substances which constitute the fibrous substance of flesh or muscle, and the main solid portions of the blood, and are closely related to the materials of which the cartilage of bones and sinews and the substances of the skin, horns, hoofs, and hair are made up. Without a due supply of albuminoids no essential animal tissue can be formed, nor can the ordinary processes of life be carried on.

The albuminoids in food are digested mainly by the pepsin in the gastric juice of animals (*see page 404*). This converts them into soluble “peptones,” which are absorbed into the blood during their passage through the intestines. Their function is to supply the nitrogen which is essential to the building up of the various portions of the animal frame to which reference has been just made, and they are thus essential in liberal quantity for young growing animals, and for cows which have to produce calves and to yield milk, which is a particularly nitrogenous fluid. Albuminoids are also capable of producing heat and force, and in some degree probably may sometimes take a direct part in the formation of fat.

The amides referred to above, of which asparagine, glutamine, leucine, and tyrosine are examples, are not competent to take the place of albuminoids as flesh-formers, but the oxidation of their carbon and hydrogen results in the production of heat and force.

*Fat* is present in only very small proportions in most vegetable foods, but in some seeds it exists in large quantities—*e.g.*, in linseed, rape-seed, and cotton-seed. These seeds are only to a limited extent used in their natural state for feeding purposes. Generally speaking the bulk of the oil is first extracted from them for commercial purposes, and the residual “oil-cake” (still containing a good deal of oil) is used for feeding purposes by the farmer. Fat may be utilised by the animal for the direct production of fat in its tissues, or utilised for the maintenance of heat and production of force. But in whatever way it acts, whether directly or indirectly (a matter on which there has been much physiological controversy), its *result*, directly or indirectly, is the production of fat in a well fed animal, or the maintenance of heat and production of force in one insufficiently fed to become fat. It is perhaps to some extent directly absorbed during its passage through the animal, but is probably mainly absorbed in an altered state through the action of the bile and other digestive juices to which it is subjected on leaving the stomach and passing into the intestines.

Its food value, approximately speaking, is nearly  $2\frac{1}{2}$  times that of sugar, starch, &c.,—*i.e.*, 1 lb. of ready made fat or oil is as useful to the animal, provided it be all digested, as about  $2\frac{1}{2}$  lb. of starch, sugar, or digestible cellulose.

*Starch, sugar, and digestible cellulose* are very abundant in vegetable substances used for feeding purposes. They produce heat and force, and result in the production of fat—but neither these nor ready made fats can act properly without a due supply of albuminoids. Sugar is already soluble; starch is made soluble by the digestive action of the saliva, aided by that of the pancreatic juice. The softer portions of cellulose are digested partly by the action of the various digestive secretions and partly by other processes that take place in the intestines.

*Mineral salts* are either soluble, or are rendered sufficiently soluble by the gastric juice for their essential constituents to be taken up by the absorptive apparatus of the intestines, and so, with other products of digestion, are transferred to the blood.

Of all these constituents a proportion is retained by the animal, as already indicated, to form bone, flesh, fat, &c., &c. The “maintenance” portion, which is “burnt” or oxidised in the blood, at the expense of the air taken in by means of the lungs, is converted into water, carbonic acid gas, and (mainly) urea. The water is eliminated from the animal through the kidneys, the lungs and the skin; the carbonic acid goes off through the lungs; and the urea, containing the used-up nitrogen, through the kidneys. This urea is converted into ammonia when the urine decomposes, and it is to this that the manurial value of urine is principally due. Waste mineral salts are also eliminated chiefly in the urine.

All the woody fibre of the food and all other indigestible matter, or digestible matter that has escaped digestion, is eliminated through the intestines as fæcal matter or dung.

It must not be assumed, however, that woody fibre is useless merely because it does not itself enter into the feeding process. It is

necessary in the case of herbivorous animals for diluting or giving bulk to the real feeding constituents of the food, which would escape proper digestion if supplied in a too concentrated state.

*Water* has not yet been referred to. Although not a food in the same sense as the other constituents of diet, it is a necessary accompaniment of them. All foods contain more or less water or moisture, even the so-called "dry" foods, like grain. The so-called "succulent" foods, such as green grass, cabbages, and roots, contain a very large proportion of water, and when these are liberally used, animals consume less water in the form of drink than when they are fed mainly on dry foods, such as hay, chaff, and grain. A large use of succulent food without the addition of dry or concentrated food is often an evil, since the animal, in order to obtain the necessary quantity of actual solid food existing in the succulent form, has to take into its stomach more water than it needs. This is the case, for instance, if sheep, in cold, wintry weather are fed wholly on turnips. In order to get sufficient nutriment from the turnips, they have to eat a quantity which gives them an unnecessarily large amount of water. This water has to be raised to the high temperature of the animal's body, and to raise it to this temperature a great deal of heat is consumed, and to supply this heat food is burnt or oxidised which might otherwise go towards fattening the animal. If a moderate allowance of cake or meal (dry food) is given with the roots, it will be found that less of the latter will be consumed, with a more economical result. This is a point that appears to be very obvious when attention is directed to it, but it is nevertheless one that is too often lost sight of.

Enough has now been said to prepare the reader to understand the meanings to be attached to a numerical statement of the proportions of the various feeding constituents contained in the principal kinds of food in use on the farm, as ascertained by chemical analysis. It should be at once stated, however, that the chemical composition of a food (*i.e.*, the proportions of albuminoids, oil, starch, fibre, water, &c., contained in it) does not necessarily always indicate its feeding value. The condition of the food and its palatability are most important factors. An oilcake, for example, that may show a very good percentage of oil, albuminoids, &c., may contain some impurity that imparts a disagreeable flavour to it and prevents it from being relished or freely eaten by stock, even if it contains nothing actually deleterious to their health. On the other hand straw, chaff, and poor or badly made hay, will often be better relished and, therefore, eaten with better results if a little spice or condiment is added.

The figures that are quoted on the next page as representing the average composition of the foods commonly given to farm animals are taken from Warington's "Chemistry of the Farm" (published by Vinton & Co.), partly for the reason that they have been compiled by a very trustworthy hand, and partly because they represent in every case the mean of a large number of analyses.

## PERCENTAGE COMPOSITION OF VARIOUS FOODS.

Succulent Foods.	Water.	True Albuminoids.	Fat.	Soluble Carbohydrates, Amides, &c.	Fibre.	Ash (Mineral Matter).
Pasture Grass . . . . .	80·0	2·6	·8	10·6	4·0	2·0
Red Clover (before bloom) . . . . .	83·0	2·5	·7	7·8	4·5	1·5
Brewers' Grains, Wet . . . . .	76·6	4·8	1·1	11·1	5·2	1·2
Turnips (White) . . . . .	92·0	·5	·2	5·7	·9	·7
Swedes . . . . .	89·3	·7	·2	8·1	1·1	·6
Mangel . . . . .	88·0	·4	·1	9·6	1·0	·9
Carrots . . . . .	86·0	·7	·2	10·6	1·6	·9
Potatoes . . . . .	75·0	1·3	·2	21·5	1·1	·9
Hay and Straw.						
Clover hay . . . . .	16·0	10·2	2·2	40·3	26·0	5·3
Meadow hay . . . . .	14·3	8·3	2·5	42·4	26·3	6·2
Wheat straw . . . . .	14·3	2·9	1·2	37·0	40·0	4·6
Barley straw . . . . .	14·3	3·2	1·4	37·0	40·0	4·1
Oat straw . . . . .	14·3	3·8	2·0	36·4	39·5	4·0
Bean straw . . . . .	16·0	8·1 (?)	1·0	35·3	35·0	4·6
Cereal Grains and Offals.						
Oats . . . . .	13·0	11·9	6·0	56·4	10·0	2·7
Wheat . . . . .	12·3	10·2	1·8	71·6	2·4	1·7
Rye . . . . .	14·0	10·0 (?)	2·0	68·7	3·5	1·8
Barley . . . . .	14·0	10·0	2·0	64·7	7·1	2·2
Maize . . . . .	11·0	9·7	5·1	70·7	2·0	1·5
Malt Dust . . . . .	10·0	17·3	2·2	50·2	13·5	6·8
Wheat Bran . . . . .	14·0	12·3	4·0	53·5	10·1	6·1
Brewers' Grains, Dried . . . . .	9·3	19·8	7·7	44·0	15·0	4·2
Rice Meal . . . . .	10·0	11·1	12·1	47·8	9·0	10·0
Leguminous Grains.						
Beans . . . . .	14·5	22·4	1·6	49·0	9·4	3·1
Peas . . . . .	14·3	19·7	2·0	55·2	6·4	2·4
Principal Oil-Cakes.						
Linseed Cake . . . . .	11·7	25·4	11·4	35·8	9·0	6·7
"English" or Undecorticated } Cotton Cake . . . . . }	12·2	19·3	5·4	37·1	20·8	5·2
Decorticated Cotton Cake . . . . .	8·2	40·9	13·5	24·6	6·0	6·8

With regard to decorticated cotton cake Warrington adds, as a note, that the cake lately imported often contains only 8 to 10 per cent. of oil; and with regard to linseed-cake he adds that hard-pressed cakes contain 7 to 10 per cent. of oil; lightly pressed cake, 11 to 13 per cent.; and some Russian cakes as much as 14 to 20 per cent. We may add to this that since the Norfolk feeding experiments of some years ago which demonstrated the advantages of rich cake for fattening purposes, several English makers have made linseed-cakes containing as much as 15 per cent. of oil, guaranteed. It may also be stated that some American ("Western") linseed-cakes contain considerably upwards of 30 per cent. of albuminoids.

The whole of the figures given in the foregoing tables are, indeed, as already stated, *averages*, and individual samples of most of the feeding stuffs referred to may differ a good deal from these averages.

For instance the richness of root-crops depends a great deal upon the proportion of solid matter, and this obviously is related to the proportion of water in them. This, again, is determined by a great variety of circumstances, such as soil, manure, and season. So, also

is the percentage of sugar, upon which greatly depends the feeding value of the solid matter. The composition (and therefore the feeding value) of grass, clover, hay, and straw, has, in each case, a very wide range, according to the time at which it is cut or harvested. The straw from barely ripe corn is much more nutritious than that from fully ripe or over-ripe corn, being much more digestible. Thus, in actual practice, the straw of oats, which are generally cut before they get quite ripe, is probably usually more nutritious than that of wheat, which is cut riper; and the straw of barley—which is generally allowed to get dead ripe before being cut—is probably generally the least nutritious.

The variation in the value of green grass and clover, is very much greater, as it is subject to almost daily fluctuation, and even the nutritive value of hay is very dependent upon the precise time at which it is made, as well as upon the mode of making. It is usually considered that just before the time of full flowering is the best at which to cut grass for hay. Up to this point it is advantageous to leave it growing, but directly the seed begins to form, the hay-value of the grass begins to deteriorate, owing to the hardening of the tissues accompanied by an absorption of sugar and an increase in woody fibre.<sup>1</sup>

In this chapter it is not necessary to make many further explanatory remarks on the feeding properties of the different foods grown on the farm, either dry or succulent. The various modes of consumption of grass and clover, either as pasture, cut green fodder, or hay, are discussed in previous chapters devoted to farm practice, and so also with roots—and with other green crops like cabbages, rape, vetches, &c., to which it is not here deemed necessary to make any further allusion than that they are, on the whole, similar to root crops—or between green clover and root crops—in their composition and feeding properties.

It is, however, deemed right to point out at this stage the very considerable nutritive value of straw, which is too often under-estimated by farmers. Much more straw than is generally utilised for feeding purposes might be profitably chaffed and fed instead of going for litter purposes, particularly in hard and long winters, the deficiency in litter thus caused being made up for by the purchase of peat-moss litter, a ton of which goes at least two or three times as far as straw for bedding on account of its much greater absorptive properties. Straw well soaked and slightly salted is an excellent material to eke out a scanty supply of roots, some cake, or bean-meal, or pea-meal, being given to make up for its special deficiency in albuminoids.

Of the dry concentrated foods that have been mentioned, a glance at the tables shows that on the whole there is great similarity in the composition of oats, wheat, rye, barley, maize, and rice meal, if we translate oil into its value in soluble carbohydrates by multiplying it by  $2\frac{1}{2}$ . In brewers' grains dried, and in beans, peas, and the several oil-

<sup>1</sup> Readers who wish to obtain more complete information of the ascertained variations in the composition of almost all varieties of feeding-stuffs used for agricultural purposes, will find very full tables in Armsby's "Manual of Cattle Feeding," published by Messrs. Wiley & Sons, of New York.

cakes, however, we notice that we have a different class of foods—specially rich in albuminoids or nitrogenous substances. These last-named foods are, therefore, particularly valuable for raising the proportion of albuminoids in a diet largely consisting of roots and straw chaff, which are deficient in albuminoids.

Reference has been already made to the variations in the composition of oil-cakes. These variations are those occurring in genuine cakes. But other variations occur, due to the considerable and deliberate adulteration or admixture of the oil seed with inferior materials before crushing. Sometimes this, in the case of linseed-cake, is due to the use of seed imported in a dirty condition, but very frequently deliberate additions of linseed-screenings and various refuse matters are made. The cakes thus produced are often sold as “oil-cake”—to avoid the penalties that might be legally incurred by calling them “linseed-cake,” but most farmers are in the habit of calling linseed cake “oil-cake,” and so do not detect the evasion. When, therefore, linseed-cake is required the purchaser should stipulate for its purity.

Cotton-cakes also are sometimes adulterated, and, like linseed-cake, should be bought subject to the test of analysis.

It will have been seen that we have given only the total percentages of the principal chemical ingredients contained in the foods tabulated, without reference to the fact that all are not equally digestible. Many experiments have been recorded showing the proportions of albuminoids, oil, carbohydrates, &c., actually digested in different foods by the same animals under similar conditions, and also by different animals. Oxen, sheep, horses, and pigs will digest different proportions of the same food. But the subject is an exceedingly complicated one, because much must depend upon the proportion of the food given, and upon the relation it bears, physically as well as chemically, to the total rations of which it forms a part, and also upon the health and temporary condition of the animal. Any reader, however, who wishes to see an excellent summary of the scientific work that has been done in this line of research, will find it in Warington's “Chemistry of the Farm,” previously referred to.

The relationship of the albuminoids to the other constituents of food has been already spoken of, but the general sketch that has in this chapter been attempted of the functions and properties of foods would be very incomplete without a more detailed reference to this phase of the subject, because much of the success of the practical feeder depends upon how nearly, whether empirically or designedly, he complies with certain conditions which Nature has laid down as indispensable to the most successful feeding. In one direction, that of too liberal a supply of albuminoids, the farmer may probably err with practical impunity, but in the other direction—that of insufficiency—he may not err without being, directly or indirectly, a loser.

An able popular essay on “the albuminoid ratio” and its practical bearing was contributed by the late Professor Warington to the “Live Stock Journal Almanac,” 1891. As nothing so concise and at



the same time so intelligible has elsewhere been written on the subject, we have ventured to reproduce it here in its entirety.

It will be noticed by the reader that Warington draws attention to the important distinction between *total* nitrogenous matters and true albuminoids in foods, and we may therefore explain that the figures in the table of foods given on page 986 denote the percentages of *true* albuminoids, and not of total nitrogenous matters.

THE ALBUMINOID RATIO.—“A progressing science is continually in need of new terms. These new phrases, though necessary, are not unfrequently a great stumbling block to persons who, although possessing a good elementary knowledge of the facts of science, have been unable to keep themselves posted up in modern scientific developments; such persons are often baffled by new terms, although really familiar with the facts to which these terms are applied. We will commence, therefore, by stating what is meant by an ‘albuminoid ratio.’

“The phrase ‘albuminoid ratio’ was introduced some years ago by myself, and is now pretty generally adopted by English writers. In America the term employed is ‘nutritive ratio.’ The original German phrase is ‘Nährstoffverhältniss.’ All these attempt to express the same idea—the *ratio, or proportion, of the albuminoid to the non-albuminoid digestible constituents of food.* If, therefore, we speak of barley as having usually an albuminoid ratio of 1 : 8, we imply that when sheep or oxen are fed with barley of average composition, the animal digests, and receives into its system, eight parts of non-albuminous food for every one part of albuminous food.

“The idea attempted to be expressed by the ‘albuminoid ratio’ of a diet is thus a very simple one; there are, however, several facts to be borne in mind which somewhat complicate the subject. In the first place, every food contains several non-albuminous constituents, and these have not the same feeding value. The chief of these non-albuminous constituents are fats, starch, sugars, and fibre. Of these the fat is much the most valuable.

“As the proportion in different foods varies extremely, being not more than 2 per cent. in wheat or barley, and more than 15 per cent. in some cakes, it is necessary in order to place different foods on the same footing, to take into account this especially high value of fat.

“It has been usual to reckon one of fat as equivalent to two and a half of starch, and to assume that sugar and digestible fibre have the same value as starch. The amount of fat has, therefore, been usually multiplied by two and a half, and the product added to the sum of the other non-albuminous constituents, the total thus representing the whole of the non-albuminous constituents *reckoned as starch.* We have, then, to bear in mind, that for the purpose of the albuminoid ratio, the whole of the non-albuminoid constituents of any food are reckoned as starch.

“The method usually adopted is not, however, perfectly accurate.

The researches of Frankland, Stohman, and Rübner have shown that fat is not exactly two and a half times the value of starch, nor are starch, the sugars, and cellulose of precisely the same value. The most recent results show the relative values of equal weights to be about the same as follows :—

Fat . . . . .	2.29
Starch . . . . .	1.00
Cane sugar and gum . . . . .	.97
Grape sugar and milk sugar . . . . .	.90
Cellulose (about) . . . . .	.86

“ We shall thus obtain the albuminoid ratio more accurately if we reduce the various non-albuminoid constituents to their value in starch by multiplying each by the respective factors just quoted.

“ A far more serious source of error arises from the fact that in many of the ordinary analyses of foods the nitrogen of the amides and of the nitrates present is reckoned as if it existed as albuminoids ; the analyst, in fact, has not determined the albuminoids present, but he has determined the amount of nitrogen, and then reckoned that the whole of this nitrogen was present as albuminoids. It is clear, then, that when amides or nitrates are present in the food analysed, the amount of albuminoids shown in the analysis is always in excess of the truth. When the Germans employ this imperfect method of analysis they term the result arrived at ‘ Rohprotein,’ that is ‘ crude protein,’ but English analysts are unfortunately not in the habit of giving this warning. It would be better if the calculated result from the total nitrogen present was always designated as ‘ nitrogenous substance,’ and not as ‘ albuminoids.’ The present state of matters is a survival of an old practice. Formerly no method was known for determining the true albuminoids in a food, nor were chemists aware that amides were always present in certain descriptions of food. Now analysts have good methods for determining the true albuminoids present, but as yet they generally adhere to the old and easy method of determining the total nitrogen, and then multiplying its quantity by six-and-a-quarter. It is certainly surprising that with good methods in their hands so little has been done by chemists to determine the amount of true albuminoids in various foods, and that so little use has hitherto been made of the facts which have been ascertained. It must always be borne in mind that the German ratios are still based on the quantities of total nitrogen ; they are therefore in many cases not ‘ albuminoid ratios,’ but simply the ratios of nitrogenous to non-nitrogenous matter.

“ The error we have pointed out occurs, however, only with certain classes of food. Ripe seeds of all kinds contain only a small proportion of amides, unless germination has commenced. Ripe straw contains also but little amide. On the other hand, all green fodder crops, roots and tubers, contain a considerable amount of amides, and nitrates also may be present. In young grass 25 per cent. of the nitrogen usually

exist as amide; in potatoes 40 per cent.; in turnips 50 per cent.; while in mangel 63 per cent. of the nitrogen is in the form of amide and nitrate, only 37 per cent. existing as albuminoids. In well-made hay the proportion of non-albuminoid nitrogen is less than in young grass or clover. In silage, on the other hand, the amount of non-albuminoids is much increased. In sour silage one-third of the albuminoids originally present in the grass or clover has generally disappeared, the nitrogen of the altered albuminoids remaining in the form of amides or ammonium salts.

“To calculate an albuminoid ratio correctly the amides present have to be ranked with the non-albuminoid constituents of the food; we have, therefore, to inquire what is the feeding value of the amides of food as compared with starch? This has been ascertained only in the case of one of the amides—asparagine—and for the present we have no other figure to employ. The relatives of equal weights of starch and asparagine are—

Starch 1·00, Asparagine ·49.

“One point further must always be borne in mind in calculating the albuminoid ratio of a food; this is that we have to deal exclusively with the *digestible constituents* of the food. The necessity of this is obvious, for it is the character of the food assimilated by the animal that we desire to know. If a sheep receiving undecorticated cotton cake digests only 16 per cent. of the fibre present, while it digests 74 per cent. of the albuminoids, it is evident that to the sheep the cotton cake is a very different material from what it appears by the chemist’s analysis. The determinations of the proportion of each constituent digested by an animal we owe almost exclusively to German experimenters; in using their figures we have, however, to bear in mind that the numbers showing the percentage of albuminoids digested are always calculated from determinations of the *total* nitrogen in the food and excrement, and consequently do not correctly represent the digestibility of the albuminoids. The digestibility shown for the albuminoids of the food is indeed always in excess of the truth in those cases in which amides or nitrates were present, as these are easily soluble bodies, and pass readily into the system without the aid of any digestive process. It is, however, quite easy, if we know the percentage of amides and nitrates in a food, and assume that they are entirely digested, to calculate from the German figures the percentage of true albuminoids digested.

“It has been necessary to go into these details because much confusion has arisen about the albuminoid ratio: we will now turn to the practical aspect of the subject. In the following table we give a few illustrations of the ratio of albuminoids to non-albuminoids in some common foods, assumed to be of average composition. In a second column is given the ratio of nitrogenous to non-nitrogenous substance; this latter ratio will correspond nearly with those quoted by Wolff; but, as we have already seen, such ratios cannot properly be called albuminoid ratios.

	Albuminoids to Non- Albuminoids.	Nitrogenous to Non- Nitrogenous Substance.
Cotton cake (decorticated).	1 : 1·4	1 : 1·2
Linseed cake	1 : 2·6	1 : 2·3
Beans	1 : 2·7	1 : 2·3
Brewers' grains	1 : 2·9	1 : 2·8
Malt dust	1 : 4·2	1 : 2·6
Wheat bran	1 : 5·5	1 : 4·2
Oats	1 : 5·9	1 : 5·4
Pasture grass	1 : 6·4	1 : 4·0
Barley	1 : 8·0	1 : 7·3
Clover hay	1 : 7·5	1 : 5·0
Meadow hay	1 : 9·5	1 : 6·9
Maize	1 : 10·9	1 : 9·0
Turnips	1 : 12·1	1 : 5·8
Potatoes	1 : 23·5	1 : 12·2
Mangel	1 : 24·1	1 : 8·6
Barley straw	1 : 108·0	1 : 53·8

“ The advantage of knowing the albuminoid ratio of a food arises from the fact that albuminoids play a specially distinct part in nutrition. From the albuminoids the whole of the muscle and the other nitrogenous tissues of the body are formed ; no other constituent of the food shares in this function. The non-albuminoid constituents of food serve for the production of heat and work in the animal body, and for the production of fat.

“ The demand for albuminoids in the animal body is very different at different stages of its existence. A very young animal requires for rapid development a food rich in albuminoids : this fact is plainly indicated by the composition of milk. The albuminoid ratio of the milk of various animals is, on an average, as follows :—

Sow	1 : 2·2
Ewe	1 : 3·1
Cow	1 : 3·6
Goat	1 : 3·7
Ass	1 : 4·2
Mare	1 : 4·4

“ If, then, we wish to imitate nature, we must supply a young animal with the diet rich in albuminoids. Linseed, and pea meal, are both well known as excellent additions to the food of young animals. As the animal grows, the proportion of albuminoids in its food may be diminished.

“ When an animal is fully grown it can be kept in a store condition most economically by feeding with a limited quantity of food poor in albuminoids. The animal has now no increase in muscle to produce, it has merely to replace the daily waste of tissue ; the other functions of its body can all be maintained by the non-albuminoid constituents of its food. If to such an animal any excess of albuminoids is given over its actual requirements, the waste in the system becomes greater, and the cost of maintaining the animal is increased. Store cattle and sheep are generally supplied with straw chaff, and roots ; greater economy is, however, obtained when the food is less bulky, and the

amount of water consumed by the animal is thus diminished. Maize is apparently the most perfect type of a maintenance diet.

“If work is demanded from the adult animal, the quantity of food supplied must be increased in proportion to the amount of work required, but the proportion of albuminoids in the food is not necessarily to be raised. This fact has been but slowly recognised; it is confirmed, however, by a multitude of practical trials made both on men and horses. In Wolff’s recent experiments with horses, the ratio of nitrogenous to non-nitrogenous substance in their diet was diminished from 1 : 4·4 to 1 : 7·3, without any deterioration in the labour value of the diet being apparent.

“Work is performed by the energy obtained by the combustion of organic matter in the muscle; it is indifferent whether this organic matter be nitrogenous or non-nitrogenous. When an animal is doing accustomed work, or in other words, is “in training,” the daily waste of muscle is no greater than when at rest. Severe unaccustomed exertion is attended with an extra waste of nitrogenous matter. A diet tolerably rich in albuminoids would thus be advisable during training.

“The comparative values of the different constituents of food already given, express their relative capacity for the production of work. Albumin has a slightly higher value than starch, their comparative values being:—

Starch 100, Albumin 107.

“The horse has only a small power of digesting vegetable fibre. Foods like hay, and especially straw-chaff, are suitable only for a maintenance diet, or light labour. For hard work, the hay and straw must be diminished, and more digestible foods substituted, as oats, maize, or beans. In choosing what grain shall be purchased for a working horse, the farmer will be chiefly guided by its market price; the proportion of albuminoids present is sure to be sufficient. The various horse foods must, however, be combined with judgment, as some of them, as maize and bran, are more laxative than others.

“We pass next to the milk-yielding animal. We have in this case a daily production, in large quantity, of a liquid rich in albuminoid matter; with this condition there is frequently associated the production of young. The supply of albuminoid matter in the food required by a cow in full milk, if measured by the quantity of albuminoids in the products yielded, is thus greater than that demanded by any other animal on the farm. The products of the cow—milk and calf—have all of them a high albuminoid ratio; the albuminoid ratio of cow’s milk being 1 : 3·6, and that of a newly-born calf about 1 : 2. Every condition thus points to the necessity of a high albuminoid ratio in a diet suitable for a cow in full milk. The maintenance diet of a dry cow may contain only a small proportion of albuminoids, and the feeding is most economical when this is the case; but when the cow is in-calf, and still more when it is in full milk, the proportion of albuminoids in the diet must be considerably raised if the animal is to be properly sustained.

“The young grass eaten on a pasture is seen by the figures already given to be a food tolerably rich in albuminoids (alb. ratio 1 : 6.4); young clover will be still richer. A good pasture will supply a food suitable for an average production of milk. When, however, a pasture is not full of young grass, or if the milk production is above an average, additional food, rich in albuminoids, should be given. When a cow is in a stall, and fed with hay, straw-chaff, and roots, the addition of a considerable amount of rich nitrogenous food is still more necessary if the cow is to do her best. The foods recognised as especially suitable for a milking cow, as brewers' grains, wheat bran, bean meal, and cotton cake, are all characteristically rich in albuminoids, as is shown by the table already given. It is, however, quite impossible to give, as is sometimes done, a fixed albuminoid ratio for the diet of a milking cow, for the simple reason that its requirements vary so greatly in different stages of its lactation; the yield of milk by different cows is also very various. A better plan is that adopted by Sir J. B. Lawes at Rothamsted, in which the milk given by each cow is every day recorded, and the supply of cotton cake and bran is raised or diminished with the rise or fall of the yield of milk, the other foods being given *ad libitum*. Thus when a cow was yielding 1 gallon of milk per day it would receive about 2 lb. of cotton cake and 2 lb. of bran; and when yielding 5 gallons of milk, 7 lb. of cake and 7 lb. of bran. It is impossible by the best feeding to turn a badly milking cow into a good one; but it is possible by sustaining the cow with proper food at the period of her greatest milk production to prolong that profitable period very considerably.

“We come lastly to the case of the fattening animal, and here we meet with a considerable divergence of opinion as to the necessity or not for a high albuminoid ratio in the diet. There are many agricultural teachers who recommend a higher albuminoid ratio for the food of a fattening ox, sheep, or pig than they do for a cow in full milk! When we recollect that the increase which a fattening animal puts on is chiefly fat, a non-nitrogenous substance, and that the albuminoid ratio of the animal increase is really only 1 : 20, the recommendation that the diet of a fattening animal should be highly nitrogenous must certainly excite surprise. At one time it was taught by a certain school of physiologists that fat was formed solely out of albuminoids, but this idea has been abandoned as contrary to fact, and it is now admitted on all hands that fat is certainly formed in the animal from carbohydrates. The German digestion experiments show indeed that a diet poor in albuminoids is somewhat less fully digested than one richer in these constituents, but as the mischief only begins when the albuminoid ratio is lower than 1 : 8, this fact can hardly have much weight in determining the present question. If we look at the results of careful feeding experiments, we find abundant evidence in the case of pigs and sheep that a diet of no higher albuminoid ratio than 1 : 8 is capable of giving excellent results as a fattening food, if it contains a considerable amount of cereal corn; for a fattening diet must always be a concentrated diet. The results of experiments with

oxen appear less decisive, and it is easy to quote results which shall show either a great advantage or no advantage from the employment of a very nitrogenous diet. Such experiments are, however, very seldom fairly made: the comparison is usually between cake and corn, and here the nitrogenous diet has all the advantage of a considerable supply of oil in the food, while the diet poor in nitrogen contains but little fat, and this fact alone may be quite sufficient to determine a result in favour of the cake. The real advantage to be gained by the use of cake is that, being a very concentrated food, it enables us to prepare a fattening diet from such poor materials as mangel and straw-chaff.

“If we are asked, however, what foods at the present time (1891—92) are the most economical to fatten on, we reply without hesitation the nitrogenous foods, and especially cotton cake. We answer thus not because of any special superiority in the fattening quality of nitrogenous foods, but because when a farmer feeds largely with cake, or with other nitrogenous food, he obtains, in addition to a fat animal, a *very valuable manure*. This fact will remain only while the prices of such foods as cotton cake, beans, peas, and lentils are so near to those of the cereal grains. If the former foods were considerably to rise in value the advantage of using them would cease. As it is the value of the manure which turns the scale in favour of the nitrogenous foods, it must of course be borne in mind that to secure this advantage the manure must be protected from rain; if this is neglected, the cheapest fattening food, as maize, may prove the most economical.”

From the foregoing remarks by Warington it will have been gathered that for the purpose of feeding a fattening animal, the question of cost, rather than of mere composition, comes into consideration—and it may happen that sometimes it is more economical to purchase a highly nitrogenous food for fattening purposes, and sometimes on the other hand more economical to purchase a food that is essentially starchy or “carbonaceous.” Readers who have carefully pondered over the pages we have quoted from Warington, should now be in no great difficulty as to the principles on which, for fattening purposes, to compare a food; but for the sake of those who may desire ready and simple instructions for forming a rough idea of the comparative values of different feeding stuffs of known chemical composition in the light of which to compare their prices, we would give the following plan. It is true that it ignores the question of relative digestibility. But relative digestibility, although investigated, as has already been shown, by various experimenters, must necessarily depend upon a variety of causes—prominent among which are the time of feeding and quantity fed, as well as the condition of the animal. For the practical purpose of comparing the approximate values of foods this question may be for the moment ignored, and a little reflection on the part of any one with but a small knowledge of physiology, chemistry, and arithmetic, will show that little practical effect arises from leaving it aside. The manurial value, it should be

added, is roughly taken into account in the mode of calculation now described.

The reader is supposed to have before him, the ordinary chemical analyses of the feeding stuffs which he wishes to compare. The items of moisture, indigestible woody fibre, and ash he ignores for the moment—though these sometimes affect variously the question of condition or mechanical suitability when they are abnormal; but here we assume that the foods are normal and of good quality. He then takes the percentage of oil and the percentage of albuminoids, and adds them together and multiplies the total by  $2\frac{1}{2}$ . To this he adds the percentage of “mucilage, sugar, starch and digestible fibre.” The total roughly represents the relative value of the food in what for the time we may call “food units.”

Let us as an example compare an average sample of linseed cake with an average sample of wheat, taking the analytical figures given on page 986. We there find as follows:—

	Linseed Cake.	Wheat.
Oil or fat . . . . .	11·4	1·8
Albuminoids . . . . .	25·4	10·2
Starch, mucilage, sugar, &c. . . . .	35·8	71·6

Adding together the fat and albuminoids and multiplying by  $2\frac{1}{2}$  we get:—

	Linseed Cake.	Wheat
	11·4	1·8
	25·4	10·2
	<hr/>	<hr/>
	36·8	12·0
	$2\frac{1}{2}$	$2\frac{1}{2}$
	<hr/>	<hr/>
	73·6	24·0
	18·4	6·0
	<hr/>	<hr/>
	92·0	30·0
Add starch, &c. . . . .	35·8	71·6
	<hr/>	<hr/>
Total food units . . . . .	127·8	101·6

The value of the two foods in food units (including manure value) is therefore roughly as 128 to 102. Now let us assume that the cost of the linseed cake is £8 per ton, and that of the wheat £7 per ton. Then in a ton of cake costing £8 we get 128 “food units,” and in a ton of wheat costing £7, we get 102 food units. In other words each £1 spent in cake (at the price per ton named) buys 16 “food units,” while each £1 spent in wheat (at the price per ton named) buys  $14\frac{1}{2}$  units. The cake, therefore, is, under the particular circumstances assumed, the cheaper food.

The possible error of such a valuation is much diminished when foods of the same class are compared, and it will be found very useful for comparing different specimens, say, of linseed cake, in order to see which is the more economical to buy—for it often happens that cakes containing widely different percentages of oil and albuminoids are sold at prices bearing little relation to their respective composition.



# BOOK THE ELEVENTH.

ON MANURES IN GENERAL, AND THEIR APPLICATION TO CROPS.

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## CHAPTER I.

### ON NATURAL MANURES.

THE practice of manuring land has existed from remote ages. The writings of Cato, Pliny, Columella, Varro, and Virgil, prove to us that we have only been following in the steps, and endeavouring to improve on the practice, of the ancient Romans, who evidently made this important branch of agriculture a subject of careful attention. The above-named old authors give repeated directions concerning the choice, application, and preservation of various kinds of manures, both liquid and solid.

Crops, like stock, grow only in virtue of the food that is placed at their disposal either by nature or by art; and plants, like animals, vary in their feeding requirements. The sources of the food of crops are various, since the constituents of that food are diverse, plants being built up of a number of different chemical elements. Rain or atmospheric moisture, and the carbon that exists in the atmosphere in the gaseous form of carbonic acid, furnish the greatest bulk of the materials of which plants are composed, and fortunately these sources of food are practically unlimited in quantity. Unfortunately, they are, on the other hand, insufficient in themselves, and the power of plants to draw on the unlimited stores of moisture and carbon in the air is regulated by the extent of the simultaneous supply of other equally essential foods, in bestowing which nature is less lavish.

Such foods are those obtained from the soil, and it is to their economy and increase that most of the efforts of the farmer are, consciously or unconsciously, directed. These foods comprise nitrogen and mineral matters. It is true that certain plants obtain part at any rate of their nitrogen indirectly from the air, but these are chiefly, if not exclusively, leguminous plants. Their power of gaining nitrogen is vested in micro-organisms or bacteria of a special type which are present in most fertile soils. These bacteria "infect" the roots of the plants, causing swellings or nodules, in which they form colonies. Living thus in symbiosis with their host plants, the bacteria bring about the assimilation of atmospheric free nitrogen, which thus becomes true plant food. The micro-organisms can be grown independently of green plants in artificial cultures, and have been thus raised and sup-

plied to farmers on a commercial scale for the inoculation of the seeds of beans, peas, vetches, clover, &c., before sowing, so as to ensure the presence of the proper organisms for the "infection" of the roots of the young plant as soon as it appears. The practical utility of this "inoculative" treatment on any given soil can only be ascertained by actual experience.

All other farm crops appear to be dependent for their nitrogen either on the soil, or on the manure added to the soil; and all crops are wholly dependent upon the soil and on the manure by which it is enriched for the mineral or ash constituents that form an important integral part of every plant. Of these the most important are phosphoric acid, potash, and lime. These, with nitrogen, comprise, practically speaking, the constituents of plant food about which the farmer has to concern himself.

But it is always to be remembered that it is a portion only of what crops require from the soil that is thus directly added in the form of manure. A great deal of plant food is drawn from the main stock or capital of fertility which has in earlier times accumulated in the soil itself, and the presence of which in abundance distinguishes the rich soil from the poor one.

Fortunately for the permanence of our farming system, nature will not allow us to draw very excessively upon the main stock of plant food in the soil, and any attempt to over-force the soil by injudicious farming is met by a temporary exhaustion, which, however, punishes the occupier rather than the landlord. In fact the occupier of a farm cannot, except in the closing years of his tenancy, very well overstrain the resources of the soil without subsequently suffering for it himself. It is, however, legitimate and customary for him to get as much out of the soil as he can in return for his rent, and most of the customs of good farming which have been evolved by practice, assisted in some directions by science, may be regarded as so many modes of making the most of the inherent food of the soil by developing its availability and by supplementing it in the directions that are desirable. The choice and rotations of crops, tillage operations, cleaning, draining, liming, are all so many means of developing the soil food, for the right of using which the tenant pays annually; and manuring in one form or the other is the means adopted for adding to and making the most of the soil food which is by nature and by art annually rendered available.

**GREEN MANURING.**—In some districts it is found to be good practice to grow certain green crops in the intervals between ordinary rotation crops and to plough them in, their function being to retain for the use of subsequent crops certain solid food that might else be washed away in drainage, and to add to the soil certain constituents derived directly or indirectly from the air. Vetches, mustard, and rape are examples of crops suitable for this purpose. They are usually grown after wheat, and occupy the place of the bare winter fallow that ordinarily occurs between the harvesting of the wheat crop and the sowing of roots. If green food falls short in the early spring, or if hay is scarce, they will come in usefully for sheep, and in failing this they can be economically

ploughed in for manure. Thus treated they lighten the soil by adding to it a large bulk of readily decaying organic matter, the nitrogen and minerals in which form a supply of quickly available plant food for the succeeding roots. Leguminous crops, such as vetches, are particularly suitable for such catch-cropping, on account of their now well-recognised power of assimilating atmospheric nitrogen through their root-nodules, and so enriching the soil.

"Catch-cropping" of this sort is often objected to on the ground that it prevents the thorough cleaning of the land from weeds, for which purpose autumn and winter fallowing are so useful. On the other hand experience teaches that a good heavy crop of thickly-sown green stuff often "smothers" weeds, bringing about as effective a destruction as occurs in the ordinary mechanical cleaning of land. Where land, however, is foul from twitch or couch-grass, the ordinary fallowing system is perhaps more safely adhered to.

The twitch and other weeds that are removed from land in ordinary cleaning by tillage operations may be utilised by burning them into "vegetable ashes" in heaps, and afterwards spreading them. In this way their nitrogen is lost, and only their mineral constituents are utilised, but it is preferable to ploughing in, if the vitality of the creeping stems of twitch is not entirely destroyed. Trimmings of hedges and other vegetable refuse may be burnt in the same way and the ashes similarly utilised. More importance was attached formerly to the value of vegetable ashes than is now the case, seeing that the potash and phosphoric acid that they contain is less intrinsically valuable, on account of the cheap and plentiful supplies of these substances obtainable in artificial forms. Nevertheless their utilisation should not be neglected.

When carted off the land in too wet or too succulent a condition for burning, the weeds should be made into a heap and allowed to remain until the inner part has decayed; the outsides should then be worked inward by turning the heap, when a good compost manure will result. If there is any danger of the seeds of annual weeds lying dormant, it is advisable to apply the decayed mass to grass-land, upon which it will be found to exercise useful effect.

**MANURING BY MEANS OF STOCK.**—The most old-fashioned form of manuring, and the one that forms the backbone of our farming system, is manuring by means of stock,—either by feeding animals on the soil, or by carting on to the land the manure that they make in the farm-yard. For many generations we had no other manure, and the home consumption of everything but grain diminished as far as possible the annual loss of soil food, which there was no means of replacing. Now-a-days it is hopeless, however, for the farmer to content himself, even if he consumes all his green stuffs, hay and straw, with the low average produce that such a system of farming would yield him. The raw material in the way of plant food that he buys with the rent is insufficient to manufacture the crops and the meat that he must turn over year by year in order to live; and he has recourse to raw material purchased in the market, as well as that paid for at the rent audit.

This material may be purchased food—oil-cake or grain—which he uses directly for producing meat or milk, and indirectly for enriching his dung; or it may be purchased in the form of direct plant food—that is artificial manure—for increasing the weight of his crops. More commonly the farmer purchases both feeding stuffs and artificial manures. The latter we shall treat of later on. Let us for the present consider what it is that we contribute to the food resources of the soil in manuring by means of stock.

An animal is only able to assimilate a comparatively small portion of the food that it consumes. The greater portion by far of its food is temporarily spent in the maintenance of life and warmth, and some is evacuated unutilised; but only a small proportion is retained permanently by the animal. The rest is given off in breath, in perspiration, in the urine, and in the fæces or solid excreta. The matter exhaled in the breath and given off in perspiration is almost wholly aqueous and carbonaceous matter. Most of the unretained nitrogen and all the unretained mineral matters are found in the urine and fæces. Roughly speaking, it may be taken that not more than from one-fifth to one-tenth of the nitrogen and mineral salts contained in the food consumed by farm animals is stored up in their carcasses, and sold in the form of live-stock or dairy produce. The balance—the greatly preponderating balance—remains for restoration, if it be carefully treated, to the soil. In the old days when there were no purchased feeding stuffs and no purchased manures, the fertility of land was maintained entirely by taking care of this balance, and it was to avoid rapid exhaustion of the land that landlords used to bind their tenants down to sell no hay, or straw, or roots. To sell an acre of hay or roots is to part with a considerable amount of wealth in the shape of nitrogen and minerals. To consume them on the farm is to part with but a tenth part of this wealth in the form of meat and dairy produce, the great bulk being, in theory at all events, retained for re-utilisation by succeeding crops. Threshed corn was the only vegetable produce that a tenant farmer used to be allowed to export from the farm.

We said just now “in theory at all events,” because the proportion of the residual manurial value of feeding stuffs that is actually economically utilised depends upon the mode of consumption, and also upon other considerations.

When sheep or other stock are grazed, their evacuations fall directly upon the land, which thus receives all. When, however, food is consumed in the farm-yard, there are various incidental sources of loss before the excreta actually reach the land. No doubt, under bad systems of management, a large proportion of the most valuable matter in dung is lost or wasted before it reaches the land, and much is lost even under the best.

The value of the manure contributed to land by stock depends partly on the kind of stock and their age, and partly upon the food from which it is produced. Thus young growing animals that have to build up their muscles and skeletons retain more nitrogen and phosphates than do adult animals whose increase in weight is mainly of fat, which contains no nitrogen and phosphates. Again, cows in-calf or

cows in-milk utilise more nitrogen and phosphates and potash than do barren cows or oxen, for the former have to build up the body of the calf, or to produce milk, a fluid very rich in both nitrogen and minerals.

Again, the addition, to the ordinary bulky foods of the farm, of oilcake or other concentrated food, which is rich in albuminoids (nitrogenous bodies) and mineral matters, greatly enhances the value of animal excreta. Thus, it is well known that one of the best modes of manuring a grass field is to graze it with sheep, liberally supplied with linseed cake or cotton cake.

The average value of the fertilising matter resulting from the consumption of different foods by farm stock has been calculated by various chemists. The best known and most generally accepted valuations are those of Sir John Lawes and Sir Henry Gilbert, which as recently modified by Dr. J. A. Voelcker and Mr. A. D. Hall,<sup>1</sup> we quote in the Table on pages 1002 and 1003. It is to be borne in mind that these values fluctuate according to the market values of concentrated artificial manures, but as *comparative* values they may be regarded as permanently valid.

They are based on the assumption that, under average conditions, and after the various incidental losses by fermentation, &c., about half of the original nitrogen of the food, about three-quarters of the phosphates, and practically all of the potash find their way to the soil. The Table is meant to be used as a basis for estimating the residual manurial value of foods consumed in the last four years of a lapsing tenancy.

But in applying them the circumstances of each case will be regarded by the valuer, who will have to consider under what conditions the foods have been consumed, and the care exercised in the management of the dung, &c. When animals are fed on the land, whether at permanent pasture or on a field of "seeds" or turnips, the manure they furnish consists simply of their excreta, which are thus applied to the land with the least possible loss of value, although the distribution, except in the case of sheep folded, is unequal. But in arable farming the live stock that can thus be kept constitutes at best but a portion of the total live stock of the farm. For at least part of the year there will be stock maintained at the homestead, the excreta of which are obtained in the form of farm-yard manure or "dung." This material really consists of the straw or litter supplied to the animals, trodden down by them, and saturated with their excreta. On most farms, other than purely grazing farms, this "dung" contains the greater part of the manurial matter produced by the consumption of crops and of purchased food. It, therefore, under the ordinary system of farming, constitutes the great mainstay of the fertility of the farm, and it may indeed be said that a very great share of the farmer's success in cultivating his land depends upon the way in which he economises and takes care of this very important, but very easily depreciated, portion of his floating capital. This being so we feel justified in allotting some considerable space to the discussion of this product.

<sup>1</sup> Journal of the Royal Agricultural Society, vol. lxiii. 1902.

TABLE SHOWING THE COMPOSITION, MANURIAL AND

*(Revised from Luwes and*

No.	Foods.	VALUATION PER TON AS					
		Nitrogen.			Phosphoric acid.		
		Per cent. in food.	Value at 12s. per unit.	Half of value to manure.	Per cent. in food.	Value at 3s. per unit.	Three-quarters of value to manure.
			<i>s. d.</i>	<i>s. d.</i>		<i>s. d.</i>	<i>s. d.</i>
1	Decorticated cotton cake . . . . .	6.90	82 10	41 5	3.10	9 4	7 0
2	Undecorticated cotton cake . . . . .	3.54	42 6	21 3	2.00	6 0	4 6
3	Linseed cake . . . . .	4.75	57 0	28 6	2.00	6 0	4 6
4	Linseed . . . . .	3.60	43 2	21 7	1.54	4 7	3 5
5	Palm-nut cake . . . . .	2.50	30 0	15 0	1.20	3 7	2 8
6	Cocoa-nut cake . . . . .	3.40	40 10	20 5	1.40	4 2	3 1
7	Rape cake . . . . .	4.90	58 10	29 5	2.50	7 6	5 8
8	Beans . . . . .	4.00	48 0	24 0	1.10	3 4	2 6
9	Peas . . . . .	3.60	43 2	21 7	0.85	2 7	1 11
10	Wheat . . . . .	1.80	21 7	10 9	0.85	2 7	2 0
11	Barley . . . . .	1.65	19 10	9 11	0.75	2 3	1 8
12	Oats . . . . .	2.00	24 0	12 0	0.60	1 10	1 5
13	Maize . . . . .	1.70	20 5	10 2	0.60	1 9	1 4
14	Rice meal . . . . .	1.90	22 10	11 5	0.60	1 9	1 4
15	Locust beans . . . . .	1.20	14 5	7 2	0.80	2 5	1 10
16	Malt . . . . .	1.82	21 10	10 11	0.80	2 5	1 10
17	Malt culms . . . . .	3.90	46 10	23 5	2.00	6 0	4 6
18	Bran . . . . .	2.50	30 0	15 0	3.60	10 10	8 2
19	Brewers' grains (dried) . . . . .	3.30	39 7	19 9	1.61	4 10	3 8
20	Brewers' grains (wet) . . . . .	0.81	9 9	4 11	0.42	1 3	0 11
21	Clover hay . . . . .	2.40	28 10	14 5	0.57	1 9	1 4
22	Meadow hay . . . . .	1.50	18 0	9 0	0.40	1 2	0 11
23	Wheat straw . . . . .	0.45	5 5	2 8	0.24	0 9	0 7
24	Barley straw . . . . .	0.40	4 10	2 5	0.18	0 6	0 4
24	Oat straw . . . . .	0.50	6 0	3 0	0.24	0 9	0 7
26	Mangels . . . . .	0.22	2 8	1 4	0.07	0 3	0 2
27	Swedes . . . . .	0.25	3 0	1 6	0.06	0 2	0 1
28	Turnips . . . . .	0.18	2 2	1 1	0.05	0 2	0 1

COMPENSATION VALUES OF FEEDING-STUFFS.

*Gilbert's Tables, 1897.*)

MANURE.		Compensation value for each ton of the food consumed.						Foods.	No.
Potash.		Last year.	Second year.	Third year.	Fourth year.	Value at 4s. per unit, all to manure.			
Per cent. in food.	Value at 4s. per unit, all to manure.								
	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>			
2.00	8 0	56 5	28 2	14 1	7 0		Decorticated cotton cake . . . . .	1	
2.00	8 0	33 9	16 10	8 5	4 2		Undecorticated cotton cake . . . . .	2	
1.40	5 7	38 7	19 3	9 7	4 9		Linseed cake . . . . .	3	
1.37	5 6	30 6	15 3	7 7	3 9		Linseed . . . . .	4	
0.50	2 0	19 8	9 10	4 11	2 5		Palm-nut cake . . . . .	5	
2.00	8 0	31 6	15 9	7 10	3 11		Cocoa-nut cake . . . . .	6	
1.59	6 0	41 1	20 6	10 3	5 1		Rape cake . . . . .	7	
1.30	5 2	31 8	15 10	7 11	3 11		Beans . . . . .	8	
0.96	3 10	27 4	13 8	6 10	3 5		Peas . . . . .	9	
0.53	2 1	14 10	7 5	3 8	1 10		Wheat . . . . .	10	
0.55	2 2	13 9	6 10	3 5	1 8		Barley . . . . .	11	
0.50	2 0	15 5	7 8	3 10	1 11		Oats . . . . .	12	
0.37	1 6	13 0	6 6	3 3	1 7		Maize . . . . .	13	
0.37	1 6	14 3	7 1	3 6	1 9		Rice meal . . . . .	14	
0.80	3 2	12 2	6 1	3 0	1 6		Locust beans . . . . .	15	
0.60	2 5	15 2	7 8	3 10	1 11		Malt . . . . .	16	
2.00	8 0	35 11	17 11	8 11	4 5		Malt culms . . . . .	17	
1.45	5 9	28 11	14 5	7 2	3 7		Bran . . . . .	18	
0.20	0 10	24 3	12 1	6 0	3 0		Brewers' grains (dried) . . . . .	19	
0.05	0 2	6 0	3 0	1 6	0 9		Brewers' grains (wet) . . . . .	20	
1.50	6 0	21 9	10 10	5 5	2 8		Clover hay . . . . .	21	
1.60	6 5	16 4	8 2	4 1	2 0		Meadow hay . . . . .	22	
0.80	3 2	6 5	3 2	1 7	0 9		Wheat straw . . . . .	23	
1.00	4 0	6 9	3 4	1 8	0 10		Barley straw . . . . .	24	
1.00	4 0	7 7	3 9	1 10	0 11		Oat straw . . . . .	25	
0.40	1 7	3 1	1 6	0 9	0 4		Mangels . . . . .	26	
0.22	0 11	2 6	1 3	0 7	0 3		Swedes . . . . .	27	
0.30	1 2	2 4	1 2	0 7	0 3		Turnips . . . . .	28	

FARM-YARD MANURE.—The late Dr. Voelcker, Consulting Chemist to the Royal Agricultural Society of England, devoted much time to the investigation of the subject of farm-yard manure, or *dung*, as it is more generally designated. The following are his analyses of it, in its fresh and in its rotten state:—

IN ITS FRESH STATE (14 DAYS OLD).	
Water . . . . .	66·17
Soluble organic matter <sup>1</sup> . . . . .	2·48
Soluble inorganic matter (ash):—	
Soluble silica . . . . .	·237
Phosphate of lime . . . . .	·299
Lime . . . . .	·066
Magnesia . . . . .	·011
Potash . . . . .	·573
Soda . . . . .	·051
Chloride of sodium . . . . .	·030
Sulphuric acid . . . . .	·055
Carbonic acid and loss . . . . .	·218
Insoluble organic matter <sup>2</sup> . . . . .	25·76
Insoluble inorganic matter (ash):—	
Soluble silica . . . . .	·967
Insoluble silica . . . . .	·561
Oxide of iron, alumina, with phosphates . . . . .	·596
Containing phosphoric acid . . . . .	(·178)
Equal to bone earth . . . . .	(·386)
Lime . . . . .	1·120
Magnesia . . . . .	·143
Potash . . . . .	·099
Soda . . . . .	·019
Sulphuric acid . . . . .	·061
Carbonic acid and loss . . . . .	·484
	100·00
<sup>1</sup> Containing nitrogen . . . . .	·149
Equal to ammonia . . . . .	·181
<sup>2</sup> Containing nitrogen . . . . .	·494
Equal to ammonia . . . . .	·599
Whole manure contains:	
Ammonia in free state . . . . .	·034
,, form of salts . . . . .	·088
IN ITS ROTTEN STATE.	
Water . . . . .	75·42
Soluble organic matter <sup>3</sup> . . . . .	3·71
Soluble inorganic matter . . . . .	1·47
Insoluble organic matter <sup>4</sup> . . . . .	12·82
Insoluble inorganic matter . . . . .	6·58
	100·00
<sup>3</sup> Containing nitrogen . . . . .	·297
Equal to ammonia . . . . .	·360
<sup>4</sup> Containing nitrogen . . . . .	·309
Equal to ammonia . . . . .	·375
Total amount of nitrogen . . . . .	·606
Equal to ammonia . . . . .	·735

In publishing these analyses, Dr. Voelcker thus explained some of the leading features of dung as a manure:—“Chemically, it must be



considered as a perfect and universal manure. It is a universal manure, because it contains *all* the constituents which our cultivated crops require to come to perfection, and is suited for almost every description of agricultural produce. As far as the inorganic fertilising substances are concerned, we find—in farm-yard manure—potash, soda, lime, magnesia, oxide of iron, silica, phosphoric acid, sulphuric acid, hydrochloric and carbonic acid; in short, all the minerals, not one excepted, that are found in the ashes of agricultural crops. Of organic fertilising substances, we find in farm-yard manure some which are readily soluble in water, and contain a large proportion of nitrogen, and others insoluble in water, and containing, comparatively speaking, a small proportion of nitrogen. The former readily yield ammonia, the latter principally give rise to the formation of humic acids, and similar organic compounds. These organic acids constitute the mass of the brown vegetable substances, or rather mixture of substances, which, practically speaking, pass under the name of humus.

“Farm-yard manure is a perfect manure, because experience, as well as chemical analysis, shows that the fertilising constituents are present in dung in states of combination which appear to be especially favourable to the luxuriant growth of our crops. Since the number of the various chemical compounds in farm-yard manure is exceedingly great,—and many, no doubt, exist in a different state of combination from that in which they are obtained in analysing farm-yard manure—in our present state of knowledge it is impossible artificially to produce a concentrated, universal, and perfect manure, which might entirely supersede home-made dung. I do not refer to the mechanical effect which farm-yard manure is capable of producing. This mechanical effect, especially important in reference to heavy clay soils, ought to be duly regarded in estimating the value of common dung; but for the present it may suffice to draw attention to the fact that even fresh dung contains a great variety of both organic and inorganic compounds of various degrees of solubility. Thus, for instance, we find in fresh manure volatile and ammoniacal compounds, salts of ammonia, soluble nitrogenised organic matter, and insoluble nitrogenised organic substance, or no less than four different states in which the one element, nitrogen, occurs in fresh manure. In well rotted dung, the same element, nitrogen, probably is found in several other forms. This complexity of composition—difficult, if not impossible, to imitate by art—is one of the reasons which render farm-yard manure a perfect as well as a universal manure.”

By far the most valuable portions of farm-yard manure, or “dung,” are those constituents contributed by the urine of the animals which make the manure. The absorbent nature of straw is such that it can hold a large quantity of liquid without its draining away, but unless the use of litter is extravagant, it generally happens that in the farm-yard the litter becomes super-saturated, and a certain quantity of liquor flows away. The loss of this liquor involves great waste, and the loss of the dark brown liquor that flows from dung heaps that have entered into the fermenting stage may involve even greater waste, since this

contains not only the constituents of urine, but portions of the more valuable ingredients of the solid matters of the manure rendered soluble by fermentation.

Clearly, then, we must make the most of the absorbent properties of the straw, since the supply of straw is generally limited, and to do this we should allow its absorbing power to be spent only on the urine and fæcal matter that we want to preserve. If we allow the rain to fall on it, some of its absorbent power is spent in sopping up the rain, and consequently it will hold less real manurial liquor. If the rain is allowed to super-saturate it, then such portions as are not retained will be spent in washing out manurial ingredients, to the weakening of the manure and the impoverishment of the farm, if the liquid drainage is not collected.

For this reason, apart even from the important question of the comfort and good health of stock, it is advisable to have the farm-yard covered. Light iron roofing can nowadays be put up at no great expense, and probably few farmers who have once become used to a covered farm-yard would care to go back to the old open-yard system.

Even in a covered yard manure cannot be prevented altogether from draining, but if the yard be properly bricked and guttered, there is no difficulty in conducting the drainage to an underground tank, which can also be made to collect the urine from cow-sheds, &c., &c., from which tank the liquid manure can be pumped into carts and distributed where it may be required as leisure allows.

The first thing then is to take care of the dung in the course of its formation; the next is to take care of it when "made." In covered yards the dung may accumulate under foot to a considerable depth, particularly if the litter is largely in the form of roughly chaffed straw, so that the dung treads into a firm consolidated mass, or if the straw be augmented by the use of peat-moss litter, which is very much more absorptive of liquids. Eventually, however,—quickly (unless it is allowed to spoil in the rain) in the case of open yards, and less speedily in the case of closed ones, but in either case, eventually,—the dung finds its way to the "dung-heap," which must be made with proper care if we are to guard against loss by drainage and undue loss by fermentation.

It is fermentation, or "heating," that "mellows" the manure and makes it ready to exert a prompt action on the soil and crops, and this fermentation mainly goes on in the dung-heap. If it does not properly ferment, or if decomposition does not go on so expeditiously as could be wished, the admission of air will promote it. The admission of air to the dung-heap has been well termed the stimulating of a slow fire, which, if not judiciously controlled by due supplies of moisture, will result in passing into the air a large quantity of fertilising gases.

It frequently happens, however, that fermentation proceeds too rapidly for the purpose of the farmer, and thus some of the most valuable properties of the manure are lost, and the quantity also becomes seriously reduced. In such case the heaps should be immediately turned and mixed with a considerable quantity of mould; and

this operation should be repeated often enough to prevent the fermenting process from ever proceeding farther than may be necessary for the destruction of the seeds of weeds, and the decomposition of the woody fibre of the vegetable matter contained in them. The better way, however, to check undue fermentation is by pumping on it the contents of the liquid manure tank, which contains the excretions of the stock. This, indeed, is said by good authorities to be the best way of using the liquid excretions of the farm. Where "fresh" or "long" manure, as it is called, or unfermented dung, is required, the more it is compressed in the heap the better. When "rotten" or "short" manure is desired, the heap is kept as light as possible, and open to the air. How to insure these two conditions we have already shown.

The following method of making dunghills, as practised in Middlesex, was given in Mr. Middleton's Survey of that county. In the first place, all the scrapings of roads, mud of ditches and ponds, and the top-mould of gravel-pits, are spread in the most convenient spots, as bottoms for dunghills. On to these layers is carted all the dung produced on the farm, together with the whole of what can be obtained from London and the various inns on the road, and to these things are occasionally added chalk, ashes, soap-boilers' waste, bricklayers' rubbish, &c. In this state the mass or heap continues until within one month of the time for manuring the land; the whole is then turned and thoroughly mixed together, the larger clods being broken into small pieces, and the drier parts thrown into the middle. In consequence of this management, the mass becomes more intimately blended, and the putrefactive process is completely finished, while the different substances remain in a heap. At the same time, by this method of forming the basis of dung-hills, the fertilising liquor which distils during the fermentation and heat that necessarily ensue is effectually preserved, and greatly contributes to ameliorate the soil.

Mr. Thompson, of Kirby Hall, recommends "to have a pit dug in the earth into which to throw manures; the bottom of the pit is watertight, and has a slope towards the centre, where a tank is placed, so as to receive the drainings from the manure, which drainage is frequently poured over the manure, in order to keep up a regular but not excessive fermentation." He has all the vegetable refuse of the farm collected and spread over the bottom of the pit in a layer of six or eight inches thick, and on to this the manure or dung is carted. When the manure is wanted for immediate use, it should be lightly thrown together, and, after being well soaked with the tank-liquor, it should be covered with a thin layer of the soil, to absorb the volatile gases. If it is to be kept six months or more, it should be compressed, and thickly covered with soil or charred peat, so as almost entirely to exclude air.<sup>1</sup>

The most convenient situations for dunghills are contiguous to the stables and ox-stalls, to which another may be added near the house

<sup>1</sup> Journal of the Yorkshire Agricultural Society, No. 6.

and piggery. The heaps may be tended and augmented at odd times, when no other business requiring particular attention stands in the way. The *dung-meer* adjacent to the house, especially, may be easily made the receptacle of various rich and fertilizing ingredients besides dung. Thus, the scrapings of the yard after rain has fallen may be advantageously thrown in, as also may some of the nearest earth, swamp mud, straw, weeds, the dung of fowls, soot and ashes, shells, lime, and bones, the sweepings of the kitchen, woollen rags, old useless brine, urine, and in short, almost any animal or vegetable substance. The dung-heap contiguous to the barn or cow-houses may be augmented with some of the nearest soil, mud, weeds, &c.

The process of fermentation will not take place so evenly and rapidly as it ought, unless the heaps are shovelled over once or twice in the course of the summer, in order that the various ingredients may become more intimately mixed and mellowed, and consequently the sooner fit for use.

It is, lastly, useful to have good roads all round the farmyard and dung-pit; as farmers suffer loss by having their carts and cattle struggling through piles of straw, in farmyards where this is neglected.

In all cases, and under all systems, the objects to be kept in view are, that no refuse, be it fluid or solid, animal, vegetable, or mineral, shall be wasted; that the fertilising properties of the manure shall be as much concentrated and as far retained as possible; that the manure shall be so made that it may be preserved as long or as short a time as is requisite, and so combined and managed that, when applied, it shall be of that nature, and in that condition, which will best ameliorate the soil and promote the vegetation of the crop for which it is destined.

Covered or roofed-in dung-sluiques have been introduced on many farms. The sides of these are left open—the flooring, water-tight, slopes from the corners to the centre, at which point there is a grating leading to a liquid manure tank, which thus receives the drainings of the manures. A pipe also leads the liquid manure from the various buildings or stables to the tank, and by a simple arrangement of a secondary but small tank, called a “settling tank,” the solid matters are arrested and retained in this, while by a pipe properly arranged, the contents of the tank can be pumped up as desired. There are various other ways of arranging the relationship of the tank and the upper dung sluice, but the above indicates the general principle. The dung is retained by low walls—with gates at convenient points—and the roof is supported by vertical uprights.

ON THE APPLICATION OF DUNG.—A great deal has been said and written about the use of dung,—about the crops to which it is best applied, the condition in which it should be used, the time of year at which it should be put on, the quantity to be applied per acre, and the mode of spreading it or ploughing it in. Seeing, however, that dung is a universal manure and may be used in various ways for various purposes, it is not strange that so much has been written concerning it.

“Much diversity of opinion exists amongst farmers as to the state in

which farmyard manure should be applied to the land; but it is evident that this must depend upon the special purposes for which the application is made. Adhesive soils generally are most benefited by manures only slightly fermented: the increased bulk of the manure, in such cases, serving to keep soils of this class more open, which effect is still further increased by the decomposition of the manure being ultimately completed in the soil itself. The lighter classes of soils, on the contrary, require consolidation, and are more benefited by the application of well-fermented manure, which does not loosen the land to the extent that long dung does.

“The chief application of farmyard manure is to the raising of root or green crops, in which cases it is deposited in the drills, and covered up by the plough. It is also applied to fallows intended for wheat, being then equally distributed over the surface, and covered by a light ploughing immediately before sowing the seed; but the more general introduction of green crops and other improvements in agriculture having rendered this expensive preparation for wheat less necessary than formerly, its application for this purpose is becoming annually more limited. Its effects as a top-dressing to meadow-lands are also well known, though, being usually deficient in quantity for other purposes, its application for this object, unless in the vicinity of large towns, is not very extensive. As already remarked, it is suited for all soils and all crops. When it is limited in quantity, and artificial manures are employed as auxiliaries, it should be applied to the less distant fields of the farm, to economise labour in carting. It may also be advantageously used in association with artificial manures, and this is perhaps the preferable practice. It differs from them in one important particular, in that it is not adapted for the drill, or for application to growing crops. For these purposes artificial manures are eminently suited, and consequently in many cases derive much of their value.

“The usual mode of applying manure to green crops is to deposit it in the drills immediately under the seeds, but it is also frequently spread over the surface of the ground during the following operations. In this case it becomes thoroughly incorporated with the soil during the preparation which it undergoes for the crop. It is no slight advantage to have the labour of the application of the manure over in the spring, when the operations of the farm are necessarily hurried, however perfect the arrangements may be for this performance, and adequate the force employed for the purpose. The perfection of cultivation consists in the high degree of pulverisation attained as a preparation for the various crops included under the denomination of green crops, and the maintenance of this highly-pulverised state is not less necessary than its production, in order that the resources of the soil may be developed to their fullest extent; but every farmer is aware how much this is interfered with by the cartage of the manure when the tillages are nearly completed. Much of the dung applied to root-crops is made after January, and cannot therefore be applied earlier, but as large a quantity as is practicable should be got upon the land in the winter months. Its effects on the crop have also been

proved to be as great in this case as in the common method of application in May or June, especially on the better class of soils. A combination with artificial manures will be of service, as the application of them in small quantities at the time of sowing the crop will push forward the young plants until they are able to utilise the manure incorporated with the soil."

It is usually found that the ridge system answers best on heavy soils in wet climates, and the flat system on dry soils.

"The quantity of farmyard manure which should be applied depends on the state of the soil and the crop for which it is intended. Twenty tons to the acre are considered an ample allowance throughout the best cultivated districts of the country, while in others more than twice the quantity is applied. The intervals of time at which the application takes place should be taken into account in ascertaining the quantity to be applied, but more frequent applications, and in smaller quantities, would probably be found to answer the intended purpose, better than the system so generally followed. The object of the farmer should undoubtedly be directed to the production of early rather than prospective results; and it having been satisfactorily ascertained, in the case of some of the artificial manures, that an increase in quantity beyond a certain amount is productive of no beneficial effects to the immediate crop, it is worth consideration how far the same holds good as regards farmyard manure, and whether it would not be desirable to regulate the quantity applied to the wants of the earlier crops, and to repeat the application at shorter intervals, as occasion might require."<sup>1</sup>

The proper time for manuring land, and the best mode of applying the manure, are points which must be determined by the convenience of the farmer, the condition of the land, and the state of the weather. In general, however, the application of dung may be regulated in a great measure by the following rules:—

1. The land should preferably be dry, in order that it may be fit for the reception and retention of the manure which is to be ploughed in and thus incorporated with it. In the case of grass or meadow-lands, which require the manure only to be strewed or spread *on the surface* of the soil as a top-dressing, it will be best to apply it a short time before the grass begins to shoot up from the ground. On the contrary, where it is deposited *in* the earth, the most suitable time will be immediately before sowing the seeds of the crop for the nutriment of which the manure is destined to serve.

2. The dung or compost should be spread without delay (in fact, as soon as possible after it has been carried to the field), and dispersed as uniformly as may be. For this purpose, the labourers and implements should be ready on the spot. The loads should be regularly arranged in rows, and the manure immediately turned in, as it more readily decomposes in the ground when newly covered, and its whole essence is thus secured to the soil.

<sup>1</sup> Farmer's Magazine, vol. xxi. p. 61.

3. The manure being speedily mixed with the earth, should be buried at a proper depth. On most soils from three to four inches will be a sufficient depth.

4. In order to prevent any undue evaporation from taking place in hot, windy, or dry weather, care should be taken not to cart out more from the dung-stead than can be properly dispersed shortly afterwards, neither should it be shovelled about more than is absolutely necessary.

COMPOSTS.—These are of less value and importance now than in former days when artificial fertility was only obtainable with difficulty. The low price of artificial fertilisers has caused farmers to abandon the labour that used to be bestowed upon the compost heap. They are composed, as their name implies, of the most heterogeneous materials, including animal and plant refuse, road-scrappings, ditch-cleanings, and lime. To promote the fermentation of the heap it should be well mixed, sheltered from the rain, and covered with a layer of earth.

SEA-WEED.—This constitutes a useful manure available on farms near the sea, though from its bulky nature it cannot be profitably carried to a distance. It is largely used in Jersey, where it contributes materially to the maintenance of that rich condition for which, despite their natural poverty, the Jersey soils are remarkable. In many parts of Ireland it is a favourite manure with the peasants near the coast. It is also employed on the east coast of Scotland. When fresh it has much the value of farm-yard manure, and becomes more valuable in proportion as it loses its water.

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## CHAPTER II.

### ON ARTIFICIAL MANURES.

ARTIFICIAL manures are chiefly valuable on account of their concentration and consequent easy portability. They differ from dung mainly in that they merely supply the soil with plant food, and do not also depend for their effect, as the bulky material of dung does, upon their secondary or mechanical action on the texture and properties of the soil.

The term "artificial" as applied to manures is not easy to define, but we shall here use it in the sense of "purchasable" manure (excluding dung, which, it is true, is sometimes bought). Lime, chalk, &c.,

are not "manure" in the generally accepted sense and are treated of separately (see p. 1024).

Artificial manures differ in the constituents of food that they supply. Some furnish only one food, such as nitrogen or phosphorus or potassium, while others yield two or more constituents of plant food.

BONES are used in various forms as manure, but they should always be obtained by preference in as finely ground a state as possible. Coarsely crushed bones are often praised on account of their "lasting" qualities. This merely means that it is a long time before the farmer gets the full return for his outlay. Good raw bone meal contains from about 45 to 50 per cent. of phosphate of lime, and nitrogen equal to from about  $4\frac{1}{2}$  to 5 per cent. of ammonia. Bones that have been highly steamed to remove the gelatine for glue making purposes, yield a good deal more phosphate, but often nitrogen equal to only  $1\frac{1}{2}$  per cent. of ammonia. Care, therefore, should be exercised in the purchase of bone dust. Bones are essentially a phosphatic manure, but their yield of ammonia on decomposition is, as already intimated, very considerable.

FISH GUANO.—The manure thus named consists of fish offal, or sometimes of whole fish, dried and ground up. Like bones, it contains both phosphates and nitrogen, but is much richer in nitrogen than are bones. Fish guanos, according to their source and the materials of which they are made, yield from about 9 to 12 per cent. of ammonia, and from 10 to 15 per cent. (sometimes even 18 per cent.) of phosphate of lime. They often contain fish-oil, which, as it delays decomposition, renders them less serviceable as manures.

PERUVIAN GUANO consists of the accumulated excrement of sea-birds found in the more or less rainless districts of Peru. Formerly it was an exceedingly concentrated ammoniacal manure, but latterly, as the best deposits have been used up, it has assumed a different character, being richer in phosphates and poorer in nitrogen.

Genuine Peruvian guano as at present offered varies much in composition. The higher qualities yield 8 to 10 per cent. of ammonia, while the poorer ones give only about 4 per cent., but are very rich in phosphates. The superior qualities are still a favourite manure with many farmers for top dressing corn crops, though the high price and the small supply limit their use a good deal. The lower qualities, rich in phosphates and poor in nitrogen, are cheap and much to be recommended for various purposes in lieu of fine bone-meal, to which they are probably preferable.

SUPERPHOSPHATES, DISSOLVED BONES, AND DISSOLVED GUANO.—To render the action of bones more rapid, Liebig suggested their treatment with sulphuric acid, which converts part of the insoluble tribasic phosphate of lime they contain into a new compound of phosphoric acid which readily dissolves in water and softens the remainder. The same



process was afterwards applied to ground coprolites and various other forms of mineral phosphates, the manure so made being known as mineral superphosphate, to distinguish it from "dissolved bones." The raw phosphatic material for the manufacture of superphosphate, which is now an enormous chemical industry, is found in almost all quarters of the world. Very large supplies of phosphate occur in South Carolina, very similar in composition to our own Cambridge Coprolites, while other descriptions of phosphatic mineral, such as apatite, are found in Canada, Norway, France, Belgium, Germany, Spain, and the West Indies. At present the chief sources, perhaps, are Algeria and Florida. Phosphatic guanos, too, are found in many parts of the world besides Peru, and these are generally used for making high-class superphosphates or concentrated compound manures. Peruvian guano itself is also "dissolved," and, by the addition of sulphate of ammonia to make its action more rapid, is converted into a rich ammoniacal superphosphate, known as "Dissolved Peruvian Guano."

Experiments have demonstrated the fact that the conversion of mineral phosphates into superphosphate is not absolutely necessary to fit them for plant food. Very fine grinding will answer the purpose, but less satisfactorily; and there is no doubt that the simplest and most economical mode of using mineral phosphates is to make them into superphosphates. In cases where circumstances render the use of a non-acid or undissolved manure desirable, there are other sources of phosphate—bones, guano, fish-guano, or basic slag (presently to be described), which are all better than ordinary mineral phosphates merely ground.

The farmer must discriminate between real "dissolved bone" and the mixed manures now generally sold under the name of "dissolved bone compound" which are made of mineral superphosphate mixed with some bone, blood, &c., and which yield less ammonia than pure dissolved bone.

**BASIC SLAG.**—This is, comparatively speaking, a new manure. It consists of the slag obtained in removing, by a certain metallurgical process, the phosphorus with which iron, made from most English iron ores, is largely contaminated, and when ground to an impalpable powder it forms a cheap and useful manure. When it was first put on the market, it was regarded by unscientific men with some suspicion, as a bye-product of steel works seemed to them an incongruous substance for use as a fertiliser. In the course of a few years, however, it came into extensive use on the large moorland tracts on the Continent of Europe, and its employment has steadily increased in this country until it has, on much of our land, come to be regarded as indispensable, especially on heavy grass land on which it greatly encourages clover. It is especially suitable for use on land poor in lime as well as phosphates. Some soils contain so little lime that superphosphate is scarcely suitable for them, and on these—especially on heavy land—basic slag gives excellent results. On very light land bone meal is perhaps better. The phosphoric acid in basic slag does not exist as tribasic phosphate, but

as a more highly basic and much more readily available kind of phosphate. Good samples of basic slag—which is also known as basic cinder, and as Thomas's phosphate powder—contain from 14 to 18 per cent. of phosphoric acid.

**ACID AND NON-ACID PHOSPHATIC MANURES.**—Is it better to use raw or undissolved phosphatic manures, such as bones, phosphatic Peruvian guano, and basic slag, or to employ acid manures, like dissolved bones and superphosphate? This is a question which for some years has occupied much attention, and has been the subject of many experiments. At one time it was generally supposed, both by farmers and agricultural chemists, that dissolved manures, like superphosphate, were invariably to be preferred. Of late years, however, both here and abroad—especially abroad—it has been recognised that on some soils and for some purposes raw or undissolved phosphatic manures answer quite as well. Indeed, careful comparative experiments have shown that sometimes undissolved or non-acid manures give better results. How, then, are we to decide in any given case? Speaking broadly, and with some reservations, the rule may be laid down that for all crops where the soil possesses a fairly abundant quantity of lime, superphosphate is usually found the most economical and efficacious phosphatic manure; while on soils decidedly deficient in lime we should recommend bone meal, raw phosphatic guano, or basic slag. On such land, and particularly for grass, slag has repeatedly proved highly remunerative.

How are we to tell when a soil is wanting in lime? Chalky or marly soils, of course, are essentially calcareous or limy, and there we have no doubt. Moorland soils, heaths, and sandy granitic soils are generally, on the other hand, very poor in lime. But the average clay or loam, for aught we can tell from its appearance, unless we are versed in the vegetative indications of scarcity of lime, may or may not contain a fair quantity of lime. Of course a chemical analysis of the soil will indicate precisely how much lime is present, but there is a rough and ready way of forming a very fair idea on this point which any careful man can employ for himself, without calling in the aid of the professional chemist. Let a few clods or spits of the soil, taken from various parts of the field, be dried, crumbled, and well mixed together, and a few ounces of the dried soil then taken and powdered to a moderate degree of fineness. Let this be burnt to ashes at a low red heat in an iron shovel over the fire, cooled, and put into a tumbler. Next mix it thoroughly with water to a thin paste, using sufficient water to well cover the burnt earth, and let it be well stirred with a glass rod or wooden penholder (not with a spoon or anything metallic) until air-bubbles no longer escape. Then let the operator pour in an ounce or so of hydrochloric acid (commonly sold as muriatic acid, or spirit of salt), and at the same time keep the mixture stirred. If the mixture effervesces fairly briskly, it may be taken that the soil contains a fair proportion of lime. If, on the other hand, there is little or no effervescence, it may be taken that the land is deficient in lime. In the former case, speaking as a general rule, we should recommend the use of superphosphate, dissolved

bone, or dissolved guano ; in the latter, of basic cinder, bone-meal, or phosphatic Peruvian guano.

**NITRATE OF SODA.**—This is the most important, in a sense, of all the nitrogenous artificial manures, because its nitrogen is already in the form in which it is immediately available as plant-food, without having to pass through any intermediate process of chemical change or decomposition. It is a natural salt found in the earth in Chili and Peru, and is purified by washing out and recrystallisation. It contains, in its state of ordinary commercial purity, about 95 per cent. or rather more of real nitrate of soda, equal to about  $15\frac{1}{2}$  per cent. of nitrogen or 19 per cent. of ammonia.

Formerly much prejudice existed against nitrate of soda, which is really one of the most useful, and now one of the cheapest, manures at the farmer's disposal. It used once to be cried down as a mere stimulant,—a manure which acted on the crop merely as a whip, but did not feed it. No more erroneous idea has ever been propagated, and yet it still lingers in the minds of many. Nitrate of soda supplies plant food of the most concentrated and direct kind, and its action is wholly a feeding, and not a stimulating one. It is true that it contains but one essential element of plant food, viz., nitrogen, and therefore it cannot be expected to do alone the work of nourishing a crop, that requires also mineral foods, any more than starch alone would nourish an animal. For nitrate of soda to produce its proper effects either the soil must be in good condition, maintained by the plentiful use of dung, or other artificials must be supplied to supplement it. Without these conditions it will not produce a healthy increase.

Nitrate of soda is often said to be unduly exhaustive of the soil. There is no doubt that the continued free use of heavy dressings of nitrate of soda alone might leave land in a temporarily poor condition for the next season or two. Such a proceeding, however, may be dismissed as a rare and unlikely one. Self interest would prevent it except in the case of an out-going tenant, and under our present laws which provide compensation for unexhausted tenant outlay, the temptation to such a course is not great. We believe that no sitting tenant would or could, in practical farming, use nitrate of soda in such a way as to permanently injure the land—an opinion on which we wish to lay stress, because some landowners, who are not adequately instructed in the question, entertain a strong feeling of animosity towards nitrate of soda, and discourage its use amongst their tenants, lest by its lavish employment, their estates be permanently impoverished. To show how shallow, sometimes, is the knowledge that lies behind this prejudice, we have heard of a landowner who resented the use, by his tenants, of nitrate of soda, but encouraged them to use sulphate of ammonia. The one he regarded as a stimulant, the other as a food. As a matter of fact, there is no essential difference in the action of those two manures, except that one acts much more rapidly in dry weather than does the other. Sulphate of ammonia is turned into nitrate in the

soil, and, as regards their feeding or exhausting value, there is no difference between them, except that sulphate of ammonia tends to exhaust the lime on soils poor in that constituent.

**SULPHATE OF AMMONIA.**—This manure may, perhaps, be called the great rival of nitrate of soda, as it is a fertiliser equally soluble and even more concentrated, containing as much as from  $24\frac{1}{2}$  to  $25\frac{1}{2}$  per cent. of ammonia. It is produced in very large quantities from the refuse "liquor" of gas-works, and lately even from the gases of blast-furnaces,—its source being the organic nitrogen existing in the coal, which is mainly converted into ammonia when the coal is distilled for gas or burned as fuel. This ammonia, combined with oil of vitriol, forms the useful salt to which we are referring.

Sulphate of ammonia may be used for practically all purposes for which nitrate of soda is to be recommended, the chief difference being that it should be applied somewhat earlier, because its ammonia cannot act until it has undergone in the soil the process known as nitrification. In dry weather, nitrate of soda acts more quickly than sulphate of ammonia, or other manures in which the nitrogen exists in the form of either ammonia or organic matter. In wet weather, the difference in speed of action is not so great—indeed if the weather should be exceptionally wet the ammonia salt, on a freely draining soil, is even preferable to nitrate, as the latter is in danger of being washed away into the drains before the crop can get hold of it. The general result, however, of experiments on the question is that, on the whole, nitrate of soda is the more economical manure as long as it can be purchased below the price per ton of sulphate of ammonia.

This manure should not be continuously used on soil poor in lime; but the deficiency can be easily supplied by liming or chalking.

**DRIED BLOOD, SHODDY, HOOFS AND HORNS, &c.**—These are organic manures—manures, that is to say, consisting almost wholly of organic matter, containing nitrogen which is gradually converted in the soil into ammonia and nitrates. Dried blood contains nitrogen equal to from about 10 or 12 per cent. up to 16 per cent. of ammonia. Hoofs and horns are sometimes even richer. Shoddy varies in value according to the quantity of wool it contains, cotton, dirt, grease, &c., being usually present. It generally yields from 3 or 4 per cent. up to 8 or 10 per cent. of ammonia.

Of these manures, the most quickly acting is dried blood, which decomposes more rapidly than the others. Hoofs and horns are the slowest of all in action, unless they are prepared by highly drying and grinding to powder, when they decay more rapidly. These are chiefly used in market-gardening and for hops, for which last-mentioned crop most of the shoddy sold to farmers is employed.

**RAPE-DUST, &c.**—A large quantity of the rape-cake, produced in the process of crushing rape-seed to obtain its oil, is too much contaminated with wild mustard-seed (charlock) to allow of its being

used for feeding purposes. This kind of cake is generally ground up and sold as "rape-dust" for manurial purposes. It yields, on decomposition, from 5 to 6 per cent. of ammonia, and also contains 3 or 4 per cent. of phosphate of lime. It may be used on all crops, but resembles other organic nitrogenous manures in its slowness of action; it is therefore unsuitable for a top-dressing and should generally be applied in autumn, in quantities ranging from a few cwt. to  $\frac{1}{2}$  ton per acre. It is much used for hops, and is also generally regarded as a preventive of wire-worm. It probably acts by affording a palatable food on which this pest feeds instead of on the young growing crop, which is thus indirectly protected.

**SOOT.**—Soot is a manure much valued for top-dressing wheat. Its efficacy is entirely due to the sulphate of ammonia that it contains. The percentage of ammonia in it commonly ranges from about 2 to 5, and is determined mainly by the degree to which the actual soot itself is mixed with ashes, chimney-mortar, &c.

**POTASH MANURES.**—Potash in former years was a comparatively rare and expensive commercial article, being made mainly from the ashes of plants. For a long time past, however, a plentiful supply has existed in the mineral potash salts raised from mines in Germany. The potash salt most familiar to the farmer is the compound salt known as kainit, which contains about 23 per cent. of sulphate of potash. More concentrated forms of sulphate of potash, and also muriate of potash (chloride of potassium), are likewise sold for manure, and numerous experiments have shown that either is more effective for some crops than kainit in quantity sufficient to afford an equal amount of potash.

While phosphatic and nitrogenous manures tell on practically all soils, potash is much less certain in its action. Heavy land is generally independent of artificially applied potash, though clays are sometimes found in which potash is deficient. It is usually on light land, however, that potash salts are most effective. As an example we may mention that on some of the light Norfolk soils potash acts on almost all crops, affecting their yield very largely. On peaty land, too, as on the reclaimed boglands of Ireland, potash is very generally found, when tried, to be beneficial. For potatoes potash in artificial manure usually pays well, with other manures, on all classes of soil, particularly when no farmyard manure is used.

**SALT.**—Chloride of sodium, or common salt, is a material which has been for many years recognised as a useful manure, though we are still in the dark as to the precise mode in which it acts. Sodium, though always present in plants, is not an essential ingredient of their food, nor is chlorine, the other element of which salt is made up. Furthermore the soil always contains a supply of sodium, and a good deal is applied year by year in farmyard manure, while the rain

supplies a small quantity of salt, more in the neighbourhood of the sea than in inland districts, which, perhaps, accounts for the fact that near the coast the application of salt rarely produces much effect. On the whole, it is scarcely likely that the manurial action of salt is due to its direct feeding value, but rather that its good efforts are secondary, being due either to solvent and "physical" action on the soil, or to some regulating influence in the direction of the checking of overgrowth. For instance, the fact that a more healthy crop of wheat is often obtained by top-dressing with a mixture of nitrate of soda and salt than where nitrate only is used has been attributed by some to the influence of the salt in tending to retard or check growth, so that the plant does not grow too suddenly or too rankly when fed with the nitrate.

The crops for which salt has been found most beneficial are mangel and cabbage, and in numerous experiments it has greatly increased the yield of mangel at a trifling expense. Salt is also largely used as a preventive to attacks of wire-worm. Some growers of potatoes, on land subject to wire-worm, sow about 3 cwt. per acre of salt in the drills. Next to these purposes, its chief manurial utility is for grain crops, mixed, as just mentioned, with nitrate of soda.

On some soils the use of a very moderate quantity of salt "pans" the land, which, of course, is disadvantageous. But this very fact shows that salt, either by attracting moisture, or by some other property, influences the physical condition of the soil to an extent that may readily be understood to affect crops for good or ill, quite apart from any possible action of feeding them, or of preparing food for them.

**GYPSUM, OR SULPHATE OF LIME.**—This is a manure which is useful, as a rule, only on soils poor in lime, and for most purposes it is better to apply lime itself than gypsum. Sulphate of lime is a constituent of superphosphate and dissolved bones, and is therefore applied to the land whenever these manures are used. The crops on which gypsum tells more readily than on others are the leguminous crops, such as clover, beans, and peas.

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## CHAPTER III.

### ON THE GENERAL APPLICATION OF ARTIFICIAL MANURES.

**A**S a rule, soluble and rapidly acting manures are best applied in the spring, and slowly acting ones—like bones, fish-guano, shoddy, rape-dust, &c.,—in the autumn. Nitrate of soda should never be applied till it is actually required by the plant, as it is not held by the

soil, and is liable to be washed away by the winter rains. Ammonia salts are retained by the soil (unless the latter is very light and open) until nitrification takes place. Although this does not occur during the winter to a great extent, there is nevertheless no object to be served in risking loss by sowing in winter a soluble manure that begins to act very soon after it is put on in the spring.

We now proceed to give suggestions for artificially manuring some of the chief farm crops, but it should be understood that it is not intended by any means to indicate that these suggestions are the only ones that may be usefully followed. A whole treatise might be written on the manuring of any one of the crops to be enumerated, and the manures that we have briefly described may be combined in many ways. Furthermore, the same directions for manuring are not equally applicable in different parts of the country. In the north of England, for example, and in Scotland, root crops are manured far more heavily than in the south. Three or four cwt. per acre of artificial manure are sometimes found in the south to be the utmost quantity that can be economically applied to turnips—that is to say, that quantity of manure will produce the maximum yield of which the land is capable. In the north, with a different climate and a late short season, 10 and even 15 cwt. of artificial manure are profitably used for turnips.

The suggestions that follow, therefore, are not to be blindly and unreasoningly adopted, their object being merely to indicate what are generally safe systems of manuring for each of the crops mentioned, the main regard being for efficacy obtained in the simplest and cheapest way.

Compound or mixed artificial manures, of one kind or another, are prepared by many leading manufacturers, specially suited for stated crops. These preparations are often admirably adapted to their purpose, though the farmer has, naturally, to pay something extra for them beyond the cost of the raw materials of which they are compounded. Whether or not it is economical to use them depends greatly upon the price at which they are offered.

**WHEAT.**—Wheat is a crop which, in ordinary farm practice, may be said to rarely require any special application of phosphatic manure, for it has a longer life than other cereals and is generally able to find sufficient phosphates in the dung with which it is supplied, and in the residue of the phosphatic manures applied to other crops in the rotation. On light soils, however, especially if only a light dunging has been given, some phosphatic manure may well be applied at the time of sowing in the autumn—say 2 cwt. per acre of superphosphate on land rich in lime, or 2 cwt. of phosphatic Peruvian guano, or 3 cwt. of fine bone-meal, on land that is poor in lime.

In spring, wheat should be top-dressed with nitrate of soda.

Wheat, on strong clay, will stand from 1 cwt. to 1½ cwt. of nitrate of soda per acre without going down, even after a good dunging; while, if dung has been short, as much as 2 cwt. may often be used with advantage, though most farmers will regard this as too heavy. Such

dressings, however, should not be applied all at once, but should be divided into  $\frac{1}{2}$  cwt. dressings, put on at intervals of a few weeks. In this way the full benefit of the manure is insured, and an over rank or sudden spurt in growth is prevented. On light or sandy land smaller quantities must be used—from  $\frac{3}{4}$  cwt. to 1 cwt. per acre, but there are few soils on which in ordinary circumstances a suitably proportioned dose of nitrate may not be used, whether for wheat, oats, or barley. Very frequently, it is true, we hear of an overgrowth of straw and a consequently "laid" crop following on the use of nitrate of soda, but this is generally either because too much has been used or because it has been put on all at once instead of in instalments.

Fish-guano is sometimes applied in the autumn as a source of both phosphates and nitrogen, and in this case the top-dressing of nitrate should be light.

If, on the other hand, rich highly ammoniacal guano or rich dissolved guano is used as a source of both nitrogen and phosphates, it should be applied in spring.

BARLEY AND OATS.—These crops, and especially barley, should be dressed with phosphates in most cases, for being spring-sown crops, and therefore short of life, they have not the same opportunity as wheat for searching the soil for food. The phosphatic dressing—similar to those just recommended for wheat, should be put on at seed time, and top-dressings of nitrate applied later as in the case of wheat, though, as a general rule, somewhat lighter ones, especially in the case of barley. In applying nitrate of soda to barley the farmer should, the first year that he attempts it on a new farm, proceed carefully, not exceeding 1 cwt. per acre for his main crop, and trying on a small experimental portion a heavier dressing. The reason for this is that some land will not yield its best growth of barley under conditions of too high manuring, extra weight being produced at the expense of quality, which in barley is everything. A great deal depends upon the preceding crop. Barley after wheat may be profitably manured much more highly than barley after a luxuriant turnip-crop fed off on the land with cake.

TURNIPS.—This crop is generally dunged, but, even with a full dunging, it is not wise to grow turnips without an application of artificial phosphates, which seem to have a specially useful effect in advancing the growth of the plant during the earlier and more critical stage of its life. They are particularly valuable in forcing the seedling plants rapidly into the "rough leaf," and so beyond the risk of destruction by the turnip "fly," as this voracious little pest feeds by preference upon the smooth seed-leaves. Turnips, indeed, are probably the crop which more than any other is responsive to phosphatic manure, an application before sowing being on most land necessary for getting a full crop. On land poor in lime, basic slag is probably as good a phosphatic dressing for this crop as we can have, 5 or 6 cwt.



per acre being used, while on soils containing a sufficiency of lime, 3 to 5 cwt. per acre of superphosphate may be applied, the manure in either case being added at the time of drilling—preferably with or immediately under the seed.

When plenty of dung has been used, turnips do not as a rule pay for artificial nitrogenous manuring, but when only a half dressing of dung has been given, 1 cwt. of nitrate of soda per acre may be thrown along between the rows just after hoeing out or “singling.”

**MANGEL.**—Mangel will not pay for phosphatic manure as turnips do, and on good soils, when a heavy dressing of dung has been applied, phosphates are probably superfluous. When, however, only 10 or 12 tons of dung have been used, or less, phosphatic manure should be applied. On land containing plenty of lime, 3 cwt. per acre of superphosphate or dissolved bone compound will suffice, or on land poor in lime 5 or 6 cwt. of basic slag, or 3 to 4 cwt. of phosphatic Peruvian guano or fine bone-meal.

But in all cases plenty of nitrogenous manure should be used, the best form being nitrate of soda. Mangel is much more responsive to the action of nitrate of soda than is generally supposed, and as much as 3 or 4 cwt. per acre may be advantageously applied to this crop, in conjunction with dung and other artificials. If a very heavy dressing of dung is put on for mangel, probably 2 cwt. of nitrate per acre will be sufficient to increase the crop to a maximum. With a moderate dressing of dung 4 cwt. of nitrate may be applied. We are aware that a dressing of 4 cwt. of nitrate of soda for a root crop will be regarded as suspiciously high by many who have not tried its effects, on the ground that it will cause “bolting,” or an over-growth of top, or that, even if this does not occur, the growth of an unusually heavy mangel crop by its use will leave the land impoverished for the next crop. The first objection is entirely got over if the nitrate is put on in successive doses and not all at once—1 cwt. being sown before the seed, 1 cwt. at the time of singling out, and the remaining 2 cwt. in two more applications a month apart, the nitrate being simply thrown along by hand between the rows. In this way the crop is supplied with several instalments of concentrated food, and its growth is prolonged and healthily encouraged.

The objection that a heavy root crop thus grown is unduly exhaustive, has been experimentally met with a direct negative. For several years past in Essex mangel has been grown with varying dressings of nitrate and guano, and carted off the field, which has next year been sown with oats grown without any manure at all. Each plot of oats has been, like the preceding roots, carefully weighed, and when the results were compared, it was almost invariably found that the plots on which the mangel has been most heavily manured (with what are very erroneously called “stimulating” manures), and where the heaviest roots were consequently grown, were just the plots which in the following year, without further manure, produced the heaviest oat crops, as regards both grain and straw. So far

from exhausting the land, experience has indicated, year after year, that we improve it. This is probably due to the fact that the most luxuriant mangel plants leave in the soil a much greater residue, in the shape of fine rootlets, than do the poorer ones, and that these rootlets decay next year and furnish manure for the oats. Added to this there is a much greater quantity of tops, which are left on the land and ploughed in as green manure. If the manure made by consuming the roots were carted on to the land—as it is in actual farm practice—the increased fertility would be still more apparent. In fact, we believe that heavy crops cannot be systematically grown without raising the condition of the land, and, as a general rule, the more produce that we take off a field—not spasmodically, but year after year—the better is the condition of the soil and the greater its capability for growing large crops in the future, provided that liberal manuring be kept up. If it be not kept up the condition will, of course, gradually lapse back to its normal state, but no permanent exhaustion will be apparent. It would probably pay better to give a higher rent for land on which heavy crops had been raised by high manuring in ordinary rotation cropping for ten years, than a lower rent for a neighbouring farm on originally similar soil, where, for a like time, meagre crops had been grown.

**BEANS, PEAS, CLOVER, VETCHES, &c.**—These and other leguminous crops vary in their manurial requirements from the crops already considered, inasmuch as they are far less responsive to nitrogenous manuring. It has been amply proved<sup>1</sup> that leguminous plants are able to obtain a part and, if necessary, all of their nitrogen, from the nitrogen of the air, this being apparently fixed and assimilated by the aid of micro-organisms which are found in the nodules which occur on the roots of such plants. Beyond the nitrogen that they receive in dung, therefore, it is not generally found to be economical to apply nitrogen for these crops. Some striking field experiments bearing upon this point have been made by Mr. James Mason, of Eynsham Hall, Oxon.

Mineral manures may be used, that is to say, manures supplying phosphates and potash; and it has been already said that sulphate of lime or gypsum is found useful on some soils, all the leguminous crops assimilating comparatively large quantities of lime.

**ROTATION GRASSES.**—When, however, clover is grown in association with rye-grass, or other grasses, nitrogenous manuring should not be neglected, especially if such a mixture of grasses is sown as will last for two or more seasons.

Rotation grasses will stand freely heavy manuring, and afford one of the best opportunities of producing large quantities of green fodder from the land. As the farmer with this crop looks only to an immediate yield, and not to the maintenance of a fine herbage and good

<sup>1</sup> See "The Sources of the Nitrogen of our Leguminous Crops," by Sir J. B. Lawes and Dr. J. H. Gilbert, in the "Journal of the Royal Agricultural Society," Vol. II., Third Series, 1891 (pages 657 to 702).

turf as in the case of permanent grass land, he can manure much more heavily.

Two cwt. of nitrate of soda per acre may generally be usefully applied—and often 3 or 4 cwt.—put on in successive doses of 1 cwt. each.

Two or 3 cwt. of superphosphate or of dissolved bones—or more if dung is scarce—may be used on limy soils; or 3 cwt. of bone-meal or of phosphatic Peruvian guano, or 5 cwt. of basic slag, on soils poor in lime. On light soils, 2 or 3 cwt. of kainit is often useful.

**PERMANENT PASTURE.**—Permanent grass land must be, as a rule, more carefully treated. The phosphatic manures already mentioned, with kainit on light land, are suitable dressings; but from 1 cwt. to 2 cwt. of nitrate of soda or sulphate of ammonia is generally the maximum dose of strong nitrogenous manure that is desirable. If it be wished to keep up the leguminous constituents of the herbage, 1 cwt. should not be exceeded, as a larger dressing is apt to favour too much the purely gramineous constituents of the pasture.

Probably the best way to keep up a good permanent condition of grass land is to rely largely for nitrogenous manure on the excreta of sheep fed on the land with a liberal allowance of cake, phosphatic manure only being artificially applied.

Undissolved manures, like bones, guano, and basic slag (see p. 1013), are best applied to grass land in the autumn.

**HOPS.**—This crop is generally largely manured with bulky nitrogenous manures such as hoofs and horns, rape-dust or shoddy, dug in in the autumn, whilst 4 to 6 cwt. of nitrate of soda applied early in the season, will generally be found to be a useful addition. Phosphatic manures should be applied liberally, and also potash salts, unless much dung is used.

**POTATOES.**—Potatoes on most land pay well for potash manures in addition to dung and other artificial fertilisers. They are generally regarded as a drawing or exhausting crop, but if liberal manuring is resorted to they do not impair the immediate fertility of the soil as they do when treated parsimoniously.

It has been shown by a great number of experiments that what is called a "complete dressing" of artificial manures, with 10 tons of farmyard manure, will ensure at least as good a yield of potatoes as 20 tons of the latter alone. The artificial manures and quantities usually found most advantageous are 4 cwt. per acre of superphosphate,  $1\frac{1}{2}$  to 2 cwt. of sulphate of ammonia, and  $1\frac{1}{2}$  to 2 cwt. of sulphate or muriate of potash, applied in the drills at the time of planting. When no farmyard manure is available, a dressing of nitrate of soda in addition,  $1\frac{1}{2}$  cwt. per acre, is sometimes applied just before earthing up the crop.

**CABBAGES.**—Cabbages, Kale, or Kohl-rabi, will stand very heavy manuring. Bulky organic manures are often used, and guano may be

liberally applied. Provided that a good dressing of phosphates is given, nitrate of soda to the extent of 3 or 4 cwt. per acre may be put on with good effect, and on some soils salt is very useful. Light land, and even heavy land poor in potash, should get a few cwt. of kainit.

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## CHAPTER IV.

### ON THE APPLICATION OF LIME, CHALK, MARL, &C.

WITH the object of improving soils and of bringing them more nearly to resemble the typical loam, which is most generally suited to agricultural purposes, various earthy matters are sometimes brought upon and incorporated with soils which possess too great a proportion of one ingredient, and correspondingly too little of another. A sandy soil may thus be made stiffer, less porous, and more retentive of moisture, by the addition of clay. A soil containing an excess of organic matter—a peaty soil, for example—may be improved by the application of lime. The effect of such substances as lime, chalk, marl, and clay is partly physical and partly chemical,—in any case, it should be ameliorative.

The substances of a calcareous nature which are thus used include shell-sand, chalk, lime, and marl.

SHELLY OR CALCAREOUS SAND is obtainable on many parts of the sea-coast, and consists of the fine calcareous matter produced by the disintegration of marine shells. This material is best adapted for cold, clayey, or loamy soils, on which it will serve to increase the yield of crops. The quantity applied per acre is usually 18 to 20 tons, though the peculiar nature and other circumstances of the soil or situation, as well as the greater or less proportion of calcareous matter it already contains, will necessarily cause a modification in this respect. A moderate quantity of calcareous matter, thus finely divided, will produce as great an effect as a much larger dressing of marl, as it can be spread more uniformly upon the land, and more intimately blended with the soil. When laid on grass land deficient in lime, it speedily improves it. The finer the grain of the shell-sand the more speedy is its effect, and the shorter is the period of its duration.

CHALK.—Of this material there are two kinds: the one soft and unctuous, which supplies the best dressing, in its natural state, for land; the other hard, firm, and dry, which is better adapted for the purpose of burning into lime. Either kind, however, affords an excellent application for compact clayey soils, into the pores of which it

insinuates itself, and thus opens the clay to the action of the sun, air, rain, and frost, so that its too cohesive particles become loose, and it is reduced to a state of pulverisation. Chalk may also be usefully employed on sandy land, which it often renders sufficiently compact for the purposes of vegetation. In laying chalk on grass lands, care should be taken to reduce the lumps, for it may be long before the weather will pulverise them sufficiently to enable them to become incorporated with the soil; and if left on the ground they will impede the scythe. The quantity per acre varies from 10 to 30 tons according to the nature of the soil to which it is applied, rich land not requiring so large a quantity as poor or light lands do. The effects of such a dressing are by no means immediate, one or two years often elapsing before they become apparent, but on soils to which it is suited it is a very permanent amelioration. Lime is more generally applied than chalk to grass and pasture lands, but when employed in considerable quantities, and pulverised, beneficial effects have been experienced from the latter, especially where the land is light and sandy.

LIME is extensively used for manuring lands; it is best applied in the "slaked" condition. Chalk, to which reference has just been made, as well as all other forms of limestone, consists of the carbonate of lime. By heating this to a sufficient extent, as in a lime-kiln, the carbonic acid gas is driven off, and the material left behind is called quicklime or caustic lime. This latter, mixed with water—a process attended by the production of much heat,—forms slaked lime. Confusion often arises through the indifferent use of the term "lime" as denoting either quicklime, slaked lime, or carbonate of lime (chalk, limestone).

When quicklime is applied to land it ought to be spread as expeditiously as possible, in order that it may be duly slaked and blended with the soil. In this form it is more especially suited for boggy, peaty, heathy, and mountainous soils; for waste lands which are over-run with fern, broom, furze, rushes, or other coarse vegetable growth that has induced an acidity unfavourable to vegetation; and for tenacious clays, which, being thereby loosened and rendered friable, are more easily worked, and more readily penetrated by the root-fibres of plants. On old sheep-walks and commons, and on low, rich, and drained meadows, which have formerly been marshes, and which contain a very considerable quantity of vegetable matter, it is also of singular benefit; for the lime, in all these cases, entering into chemical combinations in the soil, accelerates putrefaction, as well as nitrification of the organic matter of the soil, neutralizes organic acids, and generally improves both the chemical and physical condition of the land.

The quantity of lime usually spread on land varies considerably; much depends upon the quality of the lime, and still more upon the nature of the soil to which it is applied. The general allowance, in the estimation of experienced farmers, used to be from 2 to 8 tons an acre, particularly where the land has for a long time been in a

neglected and uncultivated state, and has become sour; in which case, one good application of lime was deemed better than many frequent and repeated scatterings of small quantities. Recent practice, however, has been in favour of frequent small dressings of lime as a manure, such as 5 cwt. to 6 cwt. per acre, instead of heavy applications at wide intervals. Moreover, as lime is speedily converted into carbonate of lime (chalk) after being spread upon the land, its use is being superseded to some extent by chalk, where the latter can be obtained from no great distance. In recent experiments finely ground chalk,  $1\frac{1}{2}$  cwt. in place of each cwt. of lime, has proved at least as beneficial as a manure.

Great crops have often resulted from the *first application* of quick-lime, and farmers have thus been led into the error of repeating the dressing without the addition of other manure, whereby the land has become exhausted, instead of fertilised. A *second liming* should, therefore, not be undertaken without full consideration. "Caustic lime," says a celebrated writer, "unites with the half-decomposed fibres of vegetable matter, as straw, heath, and the like: it helps their decomposition and accelerates it. By its means the dead fibres of the roots, which remain in the earth when the plant is removed, become soluble, and their elements entering into new combinations supply materials for the various crops which are grown. *So long as there is a store of organic matter in the soil, lime will be an excellent manure.* Clayey soils are better able to bear repeated limings than those of a more sandy nature, for the lime tends to loosen the texture of the former, while it often hardens the latter to such a degree as frequently to form large clots of mortar. On damp wet ground its effects are scarcely perceptible. Much of the soil's fertility depends on the gradual transformation of organic nitrogen, first into ammonia and then successively into nitrites and nitrates. The latter stages of this process, known as nitrification, are produced by micro-organisms which can only work satisfactorily in presence of lime. Hence not a little of the immediate benefit derived from lime on a soil poor in that substance. Lime also helps the production of ammonia, which precedes nitrification, and improves the mechanical condition of most soils.

MARL is calcareous clay, that is, clay containing a variable percentage of carbonate of lime. According to its quality and composition it is variously termed *stone-marl*, *argillaceous* or *clay-marl*, and *shell-marl*. The first is so denominated from its being harder than the other sorts, on account of the greater or less quantity of sandy particles it contains. Of the second kind, clay is a principal ingredient; it is of a grey-brown or reddish-brown tinge, sometimes intermixed with blue and yellow. In shell-marl, the chief component is the detritus of shells, blended with a small portion of earthy matter. All these varieties of *genuine* marl agree in effervescing with acids—the best test for examining them,—sinking in water, crackling in fire, like salt, and undergoing pulverisation on exposure to the atmosphere.

The best season for applying marl to land is in autumn and early winter, thus affording opportunity for the lumps to be shattered by

frost. The quantity varies according to the nature of the soil. For light sandy lands the argillaceous marl is preferable, as it renders them more firm and tenacious; the stone and shell-marls are, on the other hand, best adapted to stiff, clayey, and loamy soils. The average allowance for sandy ground is about fifty or sixty cubic yards per acre, although in some parts of Cheshire as much as 128 cubic yards are applied; on loose wet loams (which are greatly benefited and rendered more friable by the use of marl) it should be spread at the rate of 100 cubic yards. Much attention, however, is requisite in this respect; for should too large a proportion be spread at one time, there will be a difficulty in removing it; whereas, whenever too little appears to have been used, the deficiency may be easily remedied by resorting to frequent light dressings.

This mode of manuring is best suited to land which has been laid down with clover, rye-grass, and trefoil, in the spring, twelve months before the application of the marl, and which will remain under these crops six months afterwards. The marl will then have time to sink gradually into the soil before the latter is ploughed up, and will become in some measure incorporated with it. Great care should be taken to break all the lumps, and get the material fine by repeated harrowings and rollings, and to have all the stones gathered and carried away, in order that the grass may shoot up as soon as possible, and stock be grazing upon it. The long exposure of marl to the influence of the atmosphere is a circumstance of very considerable importance; and this is, perhaps, best effected by laying it on the surface of the land when in grass. So permanent are the fertilising properties of marl, that, if properly spread, its effects will be visible on arable land for twelve or fourteen years, and on pasture during a much longer period.

In the old times, when labour was very cheap and the returns from farming were much greater than they are now, artificial marl was sometimes made where there were no marl pits near enough to allow of the natural article being used. A compost of lime and clay was made, and exposed to the frosts of winter; or, for heavy land, sand was used in the place of clay. The practice, however, is now quite out of date, and, considering the enormous amount of labour which it involved, we doubt whether it was ever remunerative.

The ASHES OF CLAY, after it has been burned, ameliorate wet, cold, and sandy soils, and stiff clayey lands. This kind of dressing has been used in the North Riding of Yorkshire, where the ground is so sandy as to yield, with the application of other manures, only rye; whilst, with burnt clay, such land produces abundant and luxuriant crops of wheat. The quantity applied per acre varies from ten to twelve loads, and sometimes as many as thirty are used. The result is said to be so lasting as to render a repetition of *claying* unnecessary for many years. The heavy land of Suffolk, and the flats of Essex, have likewise been benefited by clay-burning; it has been found to answer in Hampshire, and Mr. Pusey tried it with success on stiff clay land in Oxfordshire. It has been extensively used in the North of

Ireland, and has been found eminently serviceable where the land has afterwards been judiciously cropped.

The good effects of this application are, however, to be attributed rather to the mechanical alterations which it produces in the soil than to any peculiarly chemically fertilising properties inherent in the burnt clay. Clods intended for burning should be pulverised with the clod-crusher before being collected into heaps; furze and bean-straw are the best fuel for the purpose. The fire should smoulder and char rather than actually burn, for charcoal of any kind is, from its porous and absorbent qualities, preferable to ashes. A steady and sufficiently strong heat should be kept up, but without flame; with this object the external air must be as far as possible excluded.

Such laborious and expensive operations as marling and claying have not been practised to any considerable extent since agricultural depression set in. Moreover, some of the objects which in past times could be attained only by means of these operations, can now be secured by the application of artificial manures.

On very light sandy soils, the operation of CLAYING, that is, applying raw clay to the land and afterwards incorporating it with the soil, is found effective in counteracting the looseness and porosity which are amongst the chief defects of soils of the kind referred to.

The various operations that have been discussed in this chapter are all illustrative of the general principle that the incorporation with any soil of mineral matter differing from it in composition and in texture will generally result in bringing it nearer to the character of the soil best suited to the purposes of the cultivator—the ideal loam. The reason that a mixing of two different soils usually effects an improvement is that each is in a position to supply some of the deficiencies of the other. Not uncommonly, this admixture takes place naturally, as where two rock formations of different mineral character crop out at the surface of the earth, side by side; the soil along the common outcrop will be more fertile than the purer soil on either formation by itself. The many familiar and well-approved operations known as chalking, liming, marling, claying, warping, and even paring and burning and green-manuring, are all directed to the amelioration of the soil, and to bringing about artificially what, in the case of alluvial soils and of soils underlaid by the common outcrop of two differently constituted formations, is effected naturally.



# BOOK THE TWELFTH.

MONTHLY CALENDARS OF FARM WORK IN ITS VARIOUS  
BRANCHES THROUGHOUT THE YEAR.

## CHAPTER I.

CALENDAR OF WORK IN CONNECTION WITH YOUNG STOCK, STORE  
CATTLE, AND FATTENING BEASTS.

OCTOBER.<sup>1</sup>

**Y**OUNG STOCK should be brought in from the outlying fields, in which they may be pastured, at night, and housed either in stalls or yards with sheltered sheds, as the night air is now often cold and damp. It is very unsafe to leave calves, weaned during the year, on low lying or damp pastures at this season, as the risk of attack from husk is very great; the danger is lessened if they are not allowed to remain out at night, but whenever there is moisture on the grass the little worm which causes the disease travels up the blades, and may find its way into the calf. Weak animals are most likely to be attacked, therefore the aim should be to keep them in an improving condition; and dry food, such as hay and rich corn, or cake, will be the most effective for the purpose. If they are kept in the yards or stalls, a mixed diet of hay, roots, and cake should be given. Yearling stock may be kept on the grass longer provided the weather is not unusually severe or wet, but the herbage contains little nutriment at this season, and, if it is desired to keep the animals in good condition, additional food must be given, either hay, roots, or cake, as may be most convenient. If they are brought into the yards a mixture of sliced or pulped roots with chaff should form their chief food, but it always pays to give them a pound or two of cake or meal a day. Cavings obtained during threshing make very good rack-meat for them at night. It is not always convenient to give hay to all the stock, but sweet straw chaffed is readily eaten, especially if it is sprinkled with meal.

*Store Stock* are, as a rule, fed chiefly upon roots and straw forage. The custom of browsing long straw and uncut roots is dying out in

<sup>1</sup> As the farmer's year, from custom, and in most instances from convenience, generally commences from Michaelmas, the following calendars have been drawn up with reference to that circumstance.

many districts, even in the Fens where excessively large crops of straw are grown, as it is found more economical and profitable to chaff the straw and slice the roots; there is also the advantage that choking is almost impossible, whereas when the roots are given whole it is not very rare. In the North of Scotland, however, most of the great feeders who send up large consignments of stock to the Smithfield Market, continue to feed long straw and hay to their fattening cattle, and roots as a rule are not sliced. Those beasts which are approaching the period of readiness for fattening off, say within three to four months from now, should have feeds of oil-cake or other good artificial food, to the weight of from two to six pounds daily; the weight being gradually increased as they increase in bulk and fatten. White turnips sown in May are the first true roots to come in, and these are followed by the yellow, but swedes are best not fed in the yards so early as this month. Cabbages are generally considered superior to "roots," and are now more often grown as autumn feed. They are undoubtedly the best succulent crop, and as they are well adapted for growing on heavy land, it would be well if more were grown for consumption in the yards between now and Christmas. Surplus potatoes not diseased may be given in the place of other roots, but they are too expensive to grow with the sole intention of feeding to stock. Parsnips and carrots are rich and nutritious; but, as they keep well, they should be eaten in winter rather than in autumn.

*Fattening Cattle.*—Push steadily forward the fattening of beasts set aside to be exhibited or sold at the Christmas fat cattle shows, by careful attention to the kind and quality of their food, the regular times at which it is given them, the general condition of their health, and the cleanliness of all connected with them. Do not disturb them oftener than is necessary. See to the quality of the water, which is of primary importance in good feeding. The eye is not a perfect judge of the quality, as the clearest-looking water is not always the purest; if there are doubts as to its purity, it will pay to have it analysed; and if good, supply it *ad libitum*, for the animals will take no more than they wish for. The allowance of oil-cake must be increased gradually as the beasts fatten; and it will best be given mixed with sliced roots and cut straw. For the beasts less advanced, feed on the food recommended by Mr. Jonas Webb (*see Text*), and with only a moderate allowance of oil-cake, for which some of the meal of home-grown produce may be substituted or added. An occasional change of food is advisable, but it should not be of too opposite a nature to that which the animals have been receiving, or they are liable to be temporarily upset. On no account substitute partially ripened roots for mature ones.

#### NOVEMBER.

*Young Stock.*—As this month is the beginning of what may be called the severe and trying months of the year for live stock of all kinds, take up young stock from outlying pasture fields and house them at the steading. The younger the stock the more need there is of warmth,

and those under a year old should be placed in the warmest quarters. It is necessary to divide them into as many lots as possible, as they never do so well when lying too thickly; a good allowance of crib-room should be provided, or the stronger will get more than their share of the food. Heifers should be kept apart from steers wherever practicable. Give clean and sweet bedding both in shed and yard, and whitewash the walls of both inside and out. See to the condition of the bowels of the animals, and be careful to keep their bodies clean and free from matted dung, &c. (We have reason to believe that young stock will be healthier, and less liable to "black-leg," out of doors during the first winter, providing they are on dry land, well sheltered, or if they have a shed to run to, and a liberal supply of nutritious food.)

*Store Cattle.*—With the exception of Runts and Highland cattle, which by the hardness of their constitution are able to withstand severe weather and exposure, and are therefore adapted for feeding off rough grass, all store stock should be brought into the yards, unless there are warm shelter-hovels for them to go into at will, where they can receive additional food. Whenever fresh purchases are made the cattle should be placed in quarantine in some outlying place for a short time, so that if any infectious or contagious disease has been communicated in the markets they will show signs of it, and the rest of the stock may be protected. Give beasts approaching the fattening period a daily allowance of oil-cake or home-made meals, the quantity increasing from two to six and eight pounds daily in proportion as they fatten. Slice roots and cut all straw fed to them, and see to the general state of their health, the condition and supply of water, and the cleanliness of bedding in shelter sheds, and also of the bodies and coats of the animals.

*Fattening Stock.*—Give a variety of foods such as home-made meals, beans, peas, seeds of tares or vetches, &c., &c., and of bought or foreign produce, as linseed and decorticated cotton-cake, lentils, carobs, or locust beans, ground down into meal, as well as of turnips and parsnips. In severe frosty weather allow at least one warm mash daily; this will be best if given before making up for the night. Keep roots in the house for some time to raise their temperature before giving them to stock; frozen or half-frozen roots affect fattening stock prejudicially. Cut, slice, or pulp them, and cut the straw, mixing the whole before feeding. Rub down daily, morning and evening, with clean dry straw, all the animals, so as to free their coats from adhering dung, and currycomb at least twice a week to free their skins from dust. Keep all feeding vessels scrupulously clean, and bed liberally with straw. When animals are in boxes it is most economical to use straw cut in lengths of about eight inches. When they are tied up, whole straw is best; it is economical to bed them down, so that the straw is first placed under the fore part of the animals; at the next bedding-down to draw it back under the belly to catch the urine; and, finally, to place it behind to catch the droppings: in this way the dung will be more evenly made, and the litter

economised. The manure as it is thrown out of the stall should be well spread about the yards, so that it may be mixed thoroughly with that which has not been so well treated.

#### DECEMBER.

*Young Stock.*—If the animals have been comfortably placed in their winter quarters during the past month, very little change need be made, for everything should have been got in order by this time, and the point to attend to is to see that they are steadily improving in condition; if they are not doing so, there can be no profit. An extra pound or two of cake or corn per day may make all the difference between profit and loss in a winter's yarding. Feed regularly,—not an allowance of cake one day and none the next. Keep the bowels open, but not too much so; in cases of constipation an increase of roots and a corresponding reduction of cake will generally have a salutary effect. Always keep a lump of rock-salt near the animals, so that they may lick it when they wish. See to the soundness of the food, the quality of the water, and the sweet condition of the bedding alike in sheds and yards if hammel-fed, and in stalls if stall-fed.

*Store Cattle.*—See remarks of last month. If pastured in outlying fields, make daily visits to the stock, and see that they are supplied with abundance of food, and that the ponds or troughs, if ice-bound, are broken up. If very severe frosts or heavy snows prevail, extra food should be given to the outlying animals, for they require more in bad weather than in good, and are unable to get as much off the pastures.

*Fattening Stock.*—This being the great month of the year for fat stock sales and shows, the few days at its beginning should be taken advantage of to prepare those animals which are to be sent for exhibition. Look well to the state of the skin and coats of the animals; rub them down daily with clean straw, and currycomb or brush them at least three times weekly. This will add greatly to their appearance as well as their health. Those animals which are ready should be carefully looked through with a view to selecting the best; and should there be a doubt as to the points or condition of any one, the doubt should be settled by the keeping back of the animal, to be sold off at the earliest opportunity. For if the feeder "goes in" for prizes at shows, and aims at a reputation for breeding fine stock, this should not be risked by carelessness in sending out doubtful animals.

Those animals not designed for the shows or sales of this month, but which are nearly ready for the butcher, should be pushed on rapidly, the best food being given and in liberal quantities, the allowance of oil-cake now reaching its maximum, which varies very much in the opinion of feeders. Some think 6 or 8 lb. daily sufficient, while others give considerably more, but it is always advisable to give a mixed ration of corn and cake instead of cake only. Cattle can be got to eat a very large quantity of corn without injury, but, if a certain point is exceeded, there is not a corresponding increase of meat, and so there is waste. When the quantity reaches nearly to the maximum that an animal can

consume, it should be increased very gradually, not more than from  $\frac{1}{4}$  lb. to  $\frac{1}{2}$  lb. at a time. So long, however, as an animal eats up its food cleanly and with relish, the system of feeding is generally right. Some stock which "take kindly" to food make greater progress on a small allowance than others on a larger.

*Store Cattle* getting on for fattening should be well fed, allowances of nutritious food being given them in addition to their usual food of turnips and straw, this being the chief if not only food of those animals which are to be grazed during the approaching summer. Give those which are making poor progress extra allowances of oil-cake or home-made meals daily.

#### JANUARY.

The cold weather which may be expected at this season will sharpen the appetites of all animals, therefore the rations should be increased. It is at this season that warm food, prepared either by steaming, or by allowing the mixed roots and chaff to ferment for 24 hours, is most beneficial, for instead of lowering the temperature of the animals as cold or frozen roots do, it will raise it, and counteract the influence of severe weather also. If any stock have to be "wintered" in outlying pasture fields, give them supplies of rich food additional to that which they may manage to pick up amongst perhaps snow-covered or ice-bound herbage. See also to the condition of the water-troughs or drinking-ponds.

*Young Stock*, housed as they should be at the steading, must be carefully attended to as regards supplies of food, clean bedding, and water. See to the state of their general health, giving special attention to that of the bowels—the best indication of the former.

*Store Cattle*.—See last month as to general directions. By this time there is likely to be offal corn to be consumed, as a large proportion of the threshing will have been done. If the food is prepared by fermenting or cooking it is sufficient if the corn is only crushed, but if the chaff is given dry it is best to have the corn ground to a fine meal so that it will mix well with the chaff, and by making the latter more palatable, will induce the animals to lick up the mixture quite cleanly. It is never safe to give meal fresh off the stones as it is liable to ferment in the stomach, thereby causing hoven or tympanitis: it should be a fortnight old so that it may have thoroughly cooled.

*Fattening Cattle*.—Much, if not all, of what was recommended to be done last month should be done this. Give as frequent changes of food as the stock in hand will admit of. In no case, in severe weather, give large feeds of cold or half-frozen roots; but, before feeding with them, keep them under cover for a day or two, and with clean—no musty—straw strewed over them. Slice and mix the roots with straw-chaff, oat-straw being the most nutritious. By way of change, pea-haulm may be given in place of straw; or, when mashes are administered, bean-straw may be cut and mixed with the turnips and the allowance of oil-cake. Pea-haulm and bean-straw should be steamed, as otherwise they are hard and indigestible.

## FEBRUARY.

*Young Stock* should be kept steadily progressing week by week, for if through neglect they are allowed to "go back," what is lost may never again be regained. This care is specially demanded during the present month—perhaps of the spring months the most trying to the health and condition of all classes of stock, as the winds are generally high, and bitterly cold and searching. See then to the proper bedding of the animals, using dry and sweet straw. Barley straw, especially in the spring months, is liable to make animals lousy; if this happens, a dressing of diluted tobacco-juice with a small quantity of paraffin should be applied, taking care to brush out any scurf previously.

To what was said last month of *Fattening Stock*, little requires to be added this month; let, however, the caution just given as to the weather be attended to, as it is specially applicable to beasts getting ready for the butcher. Cold, damp, and what is known as "muggy" weather, does more injury to cattle well advanced to the sale period, and which are, therefore, more susceptible to sudden changes and to bad weather than at earlier periods. Against the effects of both fat cattle must be specially guarded. Give the best and most nutritious food; see that the bedding is clean, dry, and sweet, the water good, and that the feeding-vessels are in a state of the most scrupulous cleanliness. Pay special attention to the state of the bowels, for if these are constipated the best food will fail of its effect. The sulphur and nitre dose is the safest and the best; many valuable cattle have owed their health, indeed their lives, to its use. Be careful, too, not to allow the animals to scour or suffer from diarrhoea, for one day's scouring will hardly be got over in a week; if they scour, withdraw part of the corn or roots for a day or two, and gradually increase the allowance afterwards. Mouldy cake is a frequent cause of scour, so cake should be carefully bought, and stored in a dry house: if broken and left in a heap for a lengthened period it is very liable to heat and mould.

## MARCH.

The cold and variable weather of March is trying to stock, the east winds which are common during this month being bad alike for man and beast; therefore, clean, dry litter should be plentifully supplied. Keeping as a rule to the recommendations we have given for the last month or two, the stock-feeder may consider that he has done all that may be reasonably demanded of him. He cannot expect—and we should be wrong if we led him to do so—that the results will be satisfactory in any sense, so far as true progress of the animals is concerned, if he has persisted, in spite of all that has been briefly hinted in this calendar, and fully explained in the text, in exposing his *Young and Store Stock* to wintry weather in outlying pasture fields, with their poor supply of herbage, and without shelter of any kind being provided. Where, however, this is persisted in, let daily visits be paid, let the food be of good quality and abundant in quantity, and let the water supply be attended to. If roots begin to run short, steaming

the chaff and adding a little extra corn will be the best means of economising them, for although roots are extremely useful they are not absolutely necessary. Many successful stock-keepers carry their animals through the winter without roots. Mangel is now getting into good condition for feeding, and as the swedes and kohlrabi fall short mangel may be substituted. Mangel grown on light land matures much earlier in the clamp than that grown on heavy soils, and may be eaten with safety and good effect soon after the commencement of the year.

*Fattening Cattle.*—Those within three or four weeks of being ready for the butcher should be finished off with regular allowances of sliced or pulped roots, and cut straw—oat straw is good, and pea-haulm is also very nutritious if it has been well harvested,—with the full allowance, six to seven pounds daily, of oil-cake or home-made meals. The more varied in kind these latter are, the better. The animals not so near the selling period will have a less allowance of these stimulating foods according to their condition. Attend to the quality of the water as an essential, to the bedding if the animals are stall-fed, and to the general and scrupulous cleanliness of the food-vessels and of the animals themselves. Do not neglect the currycomb as well as the clean straw for rubbing the animals down, nor fail to see to the condition of their bowels.

#### APRIL.

Although more genial weather may be expected, yet in many seasons the management is practically the same as during the preceding months, whilst in others a fair bite of grass may be available. One word of caution—and it is much required as a rule—must be given here: do not send the stock to the pastures at too early a period. Much loss is sustained by doing this, for the early grasses have not had time to gain their full nutrition. By being eaten down the protection afforded by the older grasses to the tender shoots of the younger ones against the early frosts is lost; while the whole is greatly deteriorated by the trampling of the animals over the soft wet surface. Two small feeds per day of sweet hay will be found distinctly beneficial whilst the grass is very young. Occasionally, autumn-sown rye is now ready for cutting, and if this is brought into the yards it will prove both acceptable and beneficial to the stock.

*Store Cattle* which have been winter-fed in sheltered fields near the steading, or in yards and sheds at the same, may be turned into outlying pastures if these are in a good enough condition, and the weather is favourable and likely to continue settled; but in bad weather this should be delayed till improvement takes place. It is much to be regretted that shelter-hovels are not more frequently met with in pastures, for animals commonly suffer when turned into fields with no protection from the wind and wet. The loss from this cause is sometimes very great, for if the animals get a chill they are thrown back in condition so much that it often takes weeks for them to recover, all of which is lost time. Any rough shelter is better than none at all. It is much the safer plan to turn the stock out permanently

at a later period of the year. If the fields are small, and this is the best arrangement for pasturing, decide upon the order in which changes from field to field should be made, according to condition of grass, &c.

For *Store* and *Fattening Cattle* the remarks of last month will apply pretty generally to this; with the proviso that much more might be made of the home-made artificial foods than is as a rule the case, and with a decided saving. In this, as in many other departments of cattle-feeding economy, the money of the stock-keeper might be saved, as also the well-being of his stock secured, by a little timely attention.

*Fattening Cattle.*—Mangel will be much more valuable at this season than swedes, so they should be given to the ripest beasts, and the swedes to those not so fresh. The addition of parsnips or carrots is an advantage. Potatoes as feeding material for fattening cattle are as much disapproved by some feeders, as they are appreciated by others, but generally they are considered more suitable for store cattle. If given to fattening cattle they should be mixed with the roots and with oil-cake or home-made meals, to which salt should invariably be added. See to the general condition of the health of the stock, special attention being paid to what has been called the "sheet anchor" of this—the bowels.

#### MAY.

The first good supplies of pasture grass may be looked for this month, and the precautions to be observed on putting stock in pasture fields have been noted in the Text. May-day is considered the best average time for turning out, but this depends very much on the district and the season. It must be remembered that the "May-day" spoken of is, according to the old reckoning, the 13th and not the 1st of the month. Stock which have hitherto been fed on winter food are changed to green pastures; the transition must be made gradually from food which has been generally dry to that which is more or less succulent. It is best to turn the stock into the pasture for a few hours a day at first until they have got quite accustomed to the change of food; the dry food they still receive in the yards will have a composing effect on the bowels, and instead of being thrown back in condition the animals will continue to steadily improve. In no case over-stock the pasture to such an extent that the grass will be too much fed down, but at the same time the herbage should not be allowed to get too much ahead of the animals, or it will grow old and stale too early in the season. All pastures are sweeter if well bared at all events once in each year.

*Fattening Cattle.*—Those of the store cattle which have been gradually ripening are now to be drafted off to supply the place of the animals which are despatched to market. Of these store animals select the best, and those likely to be got ready most quickly for the midsummer sales. To the pasture food to which towards the latter end of the month these selected animals will be put—excepting in the case of those reserved for the soiling or stall-feeding system—add a gradually increasing allowance of oil-cake or home-made meals.



Fattening beasts nearly ready for the butcher should be finished off with their maximum allowance of these nutritious foods. Place a lump of rock-salt in each pasture, so that the animals may go to it whenever they wish.

## JUNE.

*Young* as well as *Store Cattle* are now put out to pasture. Those of the latter class, approaching the period when they will be drafted to supply the place of fattening beasts sold off, should have an allowance of oil-cake given them, beginning with two pounds, or even less, daily, according to their condition. Those of the young stock which are backward and making but slow progress should have the same. When cake is low in price,—from 6*l.* to 8*l.* per ton,—the improvement it effects on the animals will repay the outlay; at the same time the pastures will be benefited. Pastures as a rule require improving, and this is one of the best ways of treating them. Change the pasture fields in the cases of both classes from time to time; a fortnight to three weeks at the most being a fair period for any one field to be occupied.

The same remarks apply to *Fattening Stock* out at grass, which should in all cases have their allowance of oil-cake or meal. Where they are *stall-fed*, the grass cut for a portion of their food should be mown in small portions at a time only, so that it may be fresh and sweet. The green forage food, as vetches, &c., &c., will now be in good condition. Add salt in all cases, and the animals stall-fed should have a lump of rock-salt in their mangers. See that the drinking-ponds and troughs in the fields are clean, well supplied, and in good order. As the cattle become fit for the butcher they should be drafted out and sold, and as the grass becomes scarce the rest of the stock will have to be diminished in number, so that, as a rule, it is not necessary to buy in many to fill up their places.

## JULY.

*Store cattle and young stock* will take the places of the fat cattle as they are sold off. If keep falls short it will be an advantage to cast out any mangel which may be left on hand; failing this, cabbages and kale will be equally good for the purpose. Vetches and clover are also very valuable, and a good supply should always be in readiness, for they prevent the loss which inevitably results if a forced sale has to be made. Change the pastures frequently. All cut food and oil-cake should be given in feeding racks, and never thrown or strewn upon the surface of the grass,—a practice which results in waste of much of the material through being trampled, breathed, and “voided” upon. Keep all classes of pastured stock free, if possible, from the attacks of flies and insects, for injurious effects of which on the health and condition see detailed remarks in the Text. As the weather is generally hot take care that the animals have a constant supply of water.

When stall-fed, *fattening cattle* should have their cut food given in small portions at a time, fresh and sweet, and with frequent changes as

to kind. Keep the houses well aired, but the animals out of draughts. See that the water is abundant and pure, and that all the food vessels are thoroughly clean. Keep the coats of animals free from dried dung, and their skins free from dust and of a healthy delicate red colour, to which end use the currycomb or hard brush and clean dry straw regularly. See that the excretions of the animals are of a healthy character, carefully avoiding all approaches to constipation or irregularity in their voidings. These and other points being attended to, stall-fed fattening stock will be as healthy as those pastured out.

#### AUGUST.

As pastures are now in many districts short of grass, either from being overstocked, or from becoming dried and parched through lack of rain, the short supplies of herbage must be supplemented by those obtained from the land which the prudent cultivator will have devoted to the growth of forage crops. The greater the variety of these, the more probable will be the success of the crops as a whole, and the wider the variations which may be made in the feeding. These advantages will be perhaps better appreciated in the case of stall-fed or soiled *fattening cattle* than in that of stock pastured in outlying fields, although in the latter they will often in certain seasons be found of great value. In pasture fields give the cut food in mangers or troughs, or in the cribs of the shelter-sheds which should be provided. For notes on the feeding of all classes of stock pastured out, and on the fattening of stall-fed cattle, see remarks under the two preceding months. Be careful to keep all fences in good repair, or stock will "gad" and break out: this is more necessary now than at any time, for if they get into a field of ripe corn they may eat sufficient to burst them. If by chance they do get into a cornfield they should for a time be kept away from water, and have linseed oil freely administered.

#### SEPTEMBER.

The "hunter's moon," in its occasional nights of "eager and nipping air," gives warning of the approach of the dreary months now near at hand, and of the necessity of bringing *young stock* and *fattening cattle* from the pasture into the yards and houses at night. Do this every night rather than run the risk of the animals suffering injury through exposure. In the case of *store stock* not yet brought in to in-lying pasture fields near the steading, or intended to be wintered in out-lying ones, see that the shelter-sheds are well cleaned out, and bedded down with clean sweet straw. Pastures, having become poor, grass must be supplemented, for all classes of stock pastured out, by cut forage food, and by white or stubble turnips, and cabbages, which ought to be ready by this time. The turnips should be sliced and mixed with the cut green food, or with the straw of the season's cereal crops cut into short lengths. The stock receiving supplies of oil-cake, &c., should have this also mixed with the other food, all of which should be given in the

racks or shed cribs or mangers. Clean out all drinking ponds, and make good their sides and bottoms; repair water troughs, and see that their supply pipes are in working order. Repair and make good the roofs and walls of shelter-sheds, and remove the dung; repair cribs and mangers, and see that the fittings of the lock-up provision boxes, &c., are in proper order. In short, make everything ready for the coming winter months.

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## CHAPTER II.

### DAIRY COW CALENDAR.

#### OCTOBER.

**T**H**ERE** is no time when cabbage is more useful for milch cows than at this season, for the grass is poor, and cabbage keeps up the flow of milk, as well as the condition of the animal, better than any other succulent food. The drumhead and cattle cabbages can be relied upon to be ready by this time, and they may be fed whole, or chopped and mixed with other coarse foods—the latter course is recommended if the animals are in the yards, the former if they are still on the pastures. If cut and mixed with the straw of the new cereal crops of the season, together with the allowance of linseed or decorticated cotton cake, or home-made meals, the food will not only be more economical, but more nutritious. Take the cows into the house at nights, as the night air at this season is cold, and raw and early frosts may set in. Better results in every way will be obtained by giving up the system of pasturing, and housing the cows wholly. If the grain-pits are not already full, they should be filled up without delay, so that they may be in readiness whenever they are required. Should the weather turn out thoroughly wet during the day, the animals even then should be housed, well rubbed down with dry straw, and have a warm mash given them. Do this also when they are taken in at night under the like circumstances. Feed the cows which are stall-fed or soiled with regularity, carefully avoiding long intervals between feeding times. The cows should be fed much on the same principle as the fattening stock, but with this difference, that the aim should be milk instead of flesh; therefore, more nitrogenous food must be given. Among the foods which increase the flow of milk and its richness, decorticated cotton cake, peas, beans, oats, linseed cake, bran and malt-dust are good; barley and wheat are too heating, and the former is generally supposed to check the secretion. Brewers' grains, distillers' wash, and silage increase the flow very much, but not the quality of the milk. Keep scrupulously clean all feeding vessels. Whitewash the walls,

previously brushing them down to free them from dust, cobwebs, &c., &c. Take advantage of the animals having their daily turn in yard or paddock to thoroughly clean out the whole interior of the house; wash down all the wood-work, and make everything neat and tidy for the winter feeding.

#### NOVEMBER.

The work to be done this month is very similar in its general character to that of last month. In-milk cows are now decidedly best off the pastures, and should be brought in to warm quarters, and placed on winter rations. A daily allowance of 40 or more pounds of roots may be given, as bulky food is necessary, and roots increase the flow of milk and make the rest of the food more tempting. They also save the more expensive foods, and as the root crop must be grown on account of the need of fallowing the arable land, it is a good way of using them to profit. Roots of the turnip family are liable to impart to milk an unpleasant smell and taste; but plants of the cabbage family, including kohlrabi, solid headed cabbages and thousand-headed kale, do not, unless the leaves are beginning to decay. Hay and hay-chaff are the best of the dry coarse foods, but, if there is not enough of these, chaffed straw and pea-haulm are very suitable for the purpose, and the difference may be made good by the addition of a little bran, or malt dust, which will induce the cows to clean up their food. The quantity of cake or corn allowed must depend to some extent on the size of the cows, but, however good the hay and roots may be, four pounds per day is the minimum that can be allowed with the hope of profit. In very damp weather with low temperature give a warm mash in the middle of the day, and keep the cows wholly in the house, omitting even the daily short run in the yard or paddock. Pay particular attention to the cows selected to be sent to the forthcoming cattle shows, and see that their general health is good. Give them food calculated to increase the flow of milk. Currycomb them regularly. Keep their coats free from all soil matter. Select calves to breed from those calved in spring. Clean out all stalls, and white-wash the parts which appear to be getting soiled.

#### DECEMBER.

Keep the animals warm and comfortable, and do not let them be disturbed more than is necessary. Maintain their bowels in a healthy condition by regular and judicious feeding, avoiding a too generous use of roots. If a fair ration of other food is given, the roots may be relied upon to rectify the action of the bowels, the quantity of roots given being increased or decreased according as the bowels are constipated or loose. In cases of persistent constipation, linseed cake with a high percentage of oil is very effective; failing this, a little crushed linseed, boiled and mixed with the food, is safe and reliable. Cooked or fermented food is very useful in cold weather, but it should not be too often used. Frosted roots should be discarded. Off-lying in-calf

cows require little cake or meal if they get a good allowance of roots, chaff, and hay; they should not be got too much into condition as, if so, there is more danger at calving time. It is a mistake however to let them get weak just before calving; the strength should be sustained at this period, because the unborn calf is making a severe demand on the cow's system. Hence, allow two pounds per day of cotton cake extra. Fattening meals, such as maize or barley, should not be given as they only increase the fat without supplying what is required to build up the frame of the calf. As the cows are being dried the food should be decreased.

## JANUARY.

To cows in full milk give ample supplies of nutritious food, those substances being selected which are known to increase the flow of milk, rather than those which have a tendency to fatten. It is not in any way a good practice to sacrifice quality of milk to quantity either in home dairying or in the milk trade. Avoid giving heavy meals of raw cold roots to cows approaching calving; slice or pulp them, and mix them with other foods. To cows within two or three weeks of calving begin to give daily an allowance of cake as recommended last month. Attend particularly to the state of the bowels, which keep gently and freely open. Cows "on note" to calve about the middle or end of March should be dried off. Begin this carefully at first, gradually decreasing the quantity of milk taken. When the udder gets hard, with a slight tendency to inflame, rub it gently several times a day with a simple cooling unguent; camphor pomatum or oil is the best. Rub only with the hand if no tendency to inflammation shows itself. Let all the animals have clean, dry stalls to lie in, and sweep out all the gutters. Take particular care to provide a good supply of fresh, sweet water at all times: it is much better for the cows to be able to drink when they wish than to only have the opportunity of doing so at stated times. If the weather is very severe it is best to use luke-warm water in order not to lower the temperature of the cow's system.

## FEBRUARY.

Do not expose cows in-calf, and especially those near their time, to cold weather, or to damp and rain. Should they by chance get wet, house them quickly, and rub them down with dry straw. Give them dry bedding and a warm mash. Give to cows, in full milk, juicy and succulent food; slice or pulp the roots, cut the straw into chaff, and make the whole into a mash, but not too warm, or too thin in consistency. Silage in moderation is useful at this season, as it is not so cold as roots; but this implies well-made silage, known as "sweet silage." If it has been made at a low temperature it has a strong sour smell, which seldom fails to communicate itself to the milk. Silage, indeed, even sweet silage, is not regarded as a desirable kind of food for the production of milk for the trade. Here, indeed, a man must be careful as to the food he gives to his cows. Add also feeds of brewers' or

distillers' wash, to promote a flow of milk. Give drying cows a modicum of hay daily. Keep the temperature of the house comfortably warm, but not close. Study the way in which the winds blow, and open and close the fresh air ventilators accordingly. Keep the stalls, wood-work, and gutters thoroughly clean. Brush down all the animals at least twice a week, thoroughly but yet not roughly—there is a good deal of art in grooming properly,—and rub them down with dry straw each time they are cleaned and bedded up. The gentle friction caused by this, especially at bedding up for the night, reduces restlessness, and predisposes them to sleep and quietness. Be careful to dry the udders thoroughly after washing them, before the cows are milked.

#### MARCH.

Mangel is now very valuable, and much more nutritious than heretofore, as it has undergone a chemical change which has converted the starch into sugar, and eliminated any objectionable principle there may have been in the roots when first stored. If the mangel should run short, the daily allowance may be partly or entirely cut off, but its place must be taken by some other equally nutritious food. A very good substitute may be found in malt-dust or bran, say three or four pounds daily, and, if a more succulent form of food is required, hot water may be thrown over the meal when being prepared the previous day. This is a very efficient and satisfactory method whenever roots are scarce. Exercise caution in exposing the animals, especially those which have recently calved, to the treacherously cold and bitter winds of the early part of this month. If cows are let out for an airing, the yard will serve better than the paddock, as the sheds will afford shelter when required. See caution given last month as to cows getting wet. Attend to the condition of cows about to calve as regards their bowels, and do not omit their daily allowance of oil-cake. Remove them to a loose box or roomy double stall; the former is preferable. Much danger is to be apprehended from the too common system of keeping cows tied up when about to calve. Give cows which have calved luke-warm drinks, avoiding large draughts of cold water. The food should be at first thin but moderately nourishing, its nutritive character being increased gradually. Rich food given suddenly is apt to induce milk fever. Draw off the milk frequently, yet gently. Keep down all distension of the udder, and look carefully for any appearances of inflammation in the same. The gentle rubbing of the udder by the dairymaid will, at this time, be peculiarly grateful to the animal. This process has often been found preventive of bad attacks. Remove frequently the old bedding, and renew it with clean sweet short-cut straw. Give a handful of good hay occasionally, and keep a lump of rock salt in the manger for the animal to lick.

#### APRIL.

Autumn-sown rye and vetches are at this season very useful for

dairy-cows, and are generally sufficiently advanced in growth to be ready by the middle of the month. Thousand-headed kale should be grown so as to be ready for cutting at this time, for it can be relied upon to afford a heavy crop, even in years when other crops are backward, and is thus a safeguard against shortness of keep at the most critical period of the dairy-year. To be really good it should have been sown in a seed-bed in the preceding spring, and transplanted out on good land in June or July. Gradually accustom the cows to this green food. Bring in cows turned out to pasture at nights, and keep them housed on cold, wet, and raw days. Keep cows in full milk housed, as they will yield more when not exposed to the cold of the pastures. For other treatment as to food, &c., &c., see previous months.

## MAY.

Cows which have been recently and are in full milk should now be yielding the largest profit. Much will, however, depend upon the feeding and general treatment. As green food ought now to be abundant, feed the cows liberally upon it, taking care to accustom them gradually to it. Give as frequent changes of food as possible, and if soiled—as this will pay best—turn the cows out to the yard or paddock daily. Brush and wisp them fairly often, and well ventilate the byres or cow-houses. Pastures should now be coming to their best, the grass being sweet, succulent, and plentiful. Turn out cows intended to be pastured; but, especially in the case of those in full milk, it will pay best to house them at night for a time. If the grass is very succulent and the cows scour, some dry food should be given to counteract it, and undecorticated cotton-cake is about the best astringent. There is no time when a little attention in this way pays better, yet it is rarely given. On thoroughly rainy days, keep the cows housed.

## JUNE.

Cows at pasture should have a change of pasture once a week so as to afford them the advantages of change of "bite," as well as to give the grass an opportunity to grow. Avoid the overstocking of pastures, as both these and the cows feeding off them will suffer. Cows soiled in the house and court should have cut grass now given them in abundance, as change from the other green forage, the various succession of crops coming in regularly to keep up the supply. If the weather is very hot the cows are best kept in the yard and soiled, otherwise they "gad," and produce but little milk. Give to cows brought in at nights from pastures a "handful" of good hay and a little oil-cake; increase the allowance of this, and the varieties of food, to animals which appear falling off in their milk. Refrigerate all milk that is to be sent to a distance; this is necessary at all seasons, but particularly throughout the hot weather.

## JULY.

The remarks of last month will apply almost wholly to this; but if

shelter sheds be not provided in the fields, take special care to house the cows during the hours when the "gad-fly" is doing its worst wherever it can. Cows near calving or far advanced in calf should, indeed, be housed during the day in hot weather, or great injury may be done them by being "gadded." Understock rather than overstock pastures, and see that the supply of water is abundant and good. Keep changing pastures, and see that the fences are well maintained.

#### AUGUST.

Observe the state of the pastures, as they begin to fail in the dry weather which in this month is so often prevalent. In such cases reduce the number of the cows pastured, or change them to a field with better grass, if there is one available. But with failing pastures it will pay better to "soil" the cows in the house, or in the sheds and courts, if there is anything to "soil" with. If this is not done, cabbage or kale should be carted on to the pastures for them. Attend to the general health of the cows; give all that are in-milk a regular supply of cake. House pastured cows during very hot days, or at least during the hours when the fly is most troublesome, and house them regularly at nights. If there is any danger of cows breaking out into the corn-fields, make the fences secure, or a whole herd may be destroyed in a night by "hoven," if they should get into a field of ripe wheat.

#### SEPTEMBER.

Failing pastures being now almost universally the rule, give to cows kept regularly out in the fields sufficient supplies of other food, as cut green forage, second-cut clover, tares, cabbage or other roots, and on housing them at night a bit of hay and a morsel of oil-cake. It will be advantageous to cows in-milk to give them towards the end of the month cooked food at least once a day, the last meal at night being the best time. Cows regularly soiled, if green forage food be yet moderately abundant, need not have this cooked mess till later in the season, or unless they begin to fail in milk. Eddish should be available now, unless the season has been too dry. Good crops of this meadow aftermath are most valuable in supplementing pastures which are falling off. Attend to the health and general condition of the cattle, and begin preparations for the coming winter.



## CHAPTER III.

## SHEEP AND LAMB CALENDAR.

## OCTOBER.

IT is somewhat difficult to decide whether Dorset ewes can be said to lamb extremely early or very late. So far as the time of year is concerned they are late, but as the aim is to produce young fat lambs before the other early breeds come in, they are more generally regarded as the first of the early breeds: this is correct also because they are the first ewes which come into season in the year. So it is safe to say they commence the lambing year. With this exception the period of lambing of ewes varies with the different localities and their climatic conditions, going on in what may be called an unbroken succession from January until April, and even up to the middle of that month, which may be regarded as the end of the lambing season of the latest, or upland, hilly, or mountainous districts. As the Dorset lambs are required to be well grown and fat by Christmas, they should be born this month, and as there is generally a good supply of green food at this season there should not be much difficulty in carrying them along. The ewes should have a good allowance of linseed-cake at first, and this may gradually be transferred to the lambs as they get strong enough to digest it. Lambs, when three months old and receiving their mother's milk, can digest and assimilate quite as much as, if not more than, when they are six months old and receive no milk. It is best to give them crushed corn in addition to cake, mixing coarsely crushed peas, oats, or beans with it; pea-husk is an excellent food for young lambs, and nothing keeps them in a more healthy condition.

Ewes go from 20 to 22 weeks with young, or about five months, so the different breeds are put to the ram five months before the time they are required to lamb, which varies according as the keep will come in for them. Thus the Hampshire and Oxford Downs are put to the ram at the end of July to produce lambs at Christmas, when the lambs are intended for showing, or for fat lamb at Easter; the rest come in later and the tuppings goes on through August and September, so that the rams may be with the ewes as late as October to catch those which missed the first time. Lambs which are to be brought up on grass are not required before the young grass can be relied upon to be in readiness for them when they are old enough to eat it. Therefore, with the exception of lambs brought up on roots, the lambing time is regulated by the time the grass shoots in spring. Hence, October is a month when a very great number of ewes will have to take the ram, and they should then be in good condition, as this will insure a heavier fall of lambs. It will be necessary to smear the rams with a mixture of oil and raddle between the fore-legs, so that the

ewes may be marked when they are served : when nearly all the ewes have been tupped the colour should be changed to blue, so that any which come to the ram again may be noted.

This is a busy month for the shepherd, as in many instances it is the commencement of the winter season on arable farms, the sheep being taken off the clovers and stubbles, and folded on roots. If the sheep have not been already dipped to destroy parasites, no time should be lost in doing this, for the wool is getting long and the sheep heavy and unwieldy. Mangel should be got up during this month, and very often considerable loss results from feeding off the leaves and small roots left behind : as there is so much risk it is doubtful economy to feed them, and unless other sheep-keep is very scarce it would be more prudent to let them rot. If they are fed, however, they should be allowed to wither and never be fed with frost on them. A free allowance of hay or other dry food should be given with them. The custom of giving dry food is often delayed too long, especially to ewes in seasons when there is a plentiful supply of green food, consequently it is generally noticed there is a heavier and more healthy fall of lambs in seasons when green crops have been deficient throughout autumn.

Hill-pastured sheep which are not thriving may recover and do well if placed in fields in which there are either naturally formed sheltered places, or better still in which sheds can be erected. See that all "stells" are in good repair. It will pay in the long run if one "stell" be provided with a small structure, in which various medicines and necessaries useful in emergencies can be stored up, under lock and key, and one part of which may afford room for a shelter for the shepherd, and be fitted with one of the small but admirably acting stoves to be had so cheaply now. By providing such a place, and with such conveniences and "stock," many a good lamb or sheep may be saved which would otherwise be lost. Attend to the general condition of the flock as regards health, and the diseases to which sheep are so liable ; provide in short as far as possible for all likely contingencies in the way of accidents, &c., &c , in the severe weather now coming on.

#### NOVEMBER.

On arable farms the sheep will now be on the roots, and will continue so throughout winter. It always pays best to slice the roots, for there is less waste, and the sheep have more time to digest them ; soft white turnips are scarcely worth slicing, for they are soft enough to gnaw and so are an exception to the rule. Cabbage is particularly useful at this season and is the best of the succulent crops, being both nutritious and safe. Many sheep are lost yearly by being put on swedes too early, that is before the roots are ripe, the amount of loss caused in this way by the upsetting of the system being incalculable ; sheep-feeders know that this risk is great so they are always prepared to give a shilling or more per head for those which are "broken in" to roots, than they are for equally good sheep straight off the grass. Cabbage is a convenient stepping-stone from grass to swedes, and the injury is avoided by

using this crop as such, therefore a good breadth of cabbage should be looked upon as essential on every farm in the autumn. Where roots are cut, one man can shepherd 200 sheep—setting the hurdles, digging out all pieces of couch in front of them, and keeping the feet sound and free from foot-rot—if the roots are got up for him.

Keep ewes which have been served, and which in forward districts are expected to lamb early, as quiet as possible; maintaining a sharp look-out upon dogs, particularly stray ones, which run among sheep and, worrying and fretting them, do them infinite harm—especially when in-lamb. Sheep, fattening for sale on the turnip brakes, should have hay supplied to them in the racks, and a daily allowance of oil-cake according to circumstances,—half a pound is generally sufficient at this season for those which are not to be sold out before March: from half to three-quarters of a pound for those not sold before the New Year: but those which are nearly fit for the butcher may be able to dispose of from 1 to 1½ lb. or even 2 lb. per day, according to size, for a short time. Straw, cut into chaff, may be substituted for hay, if additional meal is given to make it tempting to the sheep, meals or grains in like manner taking the place of the oil-cake. If the fattening sheep are being fed in or on stubble or pasture fields, the turnips with which they are supplied should then be given to them sliced and the straw or hay cut, the whole being supplied in racks; the usual method of spreading them on the ground, although it has its advantages, is not so economical unless it is for ewes, which are none the worse for a little exercise. A piece of rock salt should be supplied to each pen of sheep.

#### DECEMBER.

Swedes are generally in good condition at this season, although they often increase in size very much during this month in open weather, and as the supply of cabbage may be expected to fall short they come in very usefully. The small-topped kohlrabi should be fed off before very severe frosts set in, or it will be quite spoilt: the big-topped or hardy variety will stand almost any weather, and is useful in the early months of the year. As frosts may be expected, which will make the land too hard to permit swedes being pulled conveniently, a considerable quantity should be got up during fine, open weather, and clamped upon the land where they are to be consumed. Heaps, a chain apart, are the most convenient where the turnip-cutter is used. The roots are best topped, but not cleaned and tailed until they are required for feeding. The heaps should have a layer of straw, about 5 inches thick when compressed, spread over them, and this should be covered with a coating of earth two inches or more thick to keep out the wet. Ewes should be allowed to take a liberal amount of exercise daily, but if driven from field to field they ought not to be rushed through gateways. They must be allowed a good quantity of dry food. Towards the end of the month the lambing yard must be got ready for the ewes. Ewes should not be allowed to get over-fat, but it is a mistake to let them get muscularly weak, and as the lambs are now making a severe demand on

the systems of their dams a small quantity of nitrogenous food should be given to the latter during the month previous to lambing. About  $\frac{1}{4}$  lb. per day of decorticated cotton-cake, peas, beans, or malt-dust mixed with the chaff will repay its cost. The colder the weather, the more care must be taken as to the food of the sheep, this being good and nutritious to make up for the demands made upon their system by the cold. Should any of the hillside sheep have been overlooked in the dipping for the getting rid of parasites, no time should now be lost in attending to the animals.

#### JANUARY.

This is the coldest month in the year, and sheep require more food than at any other season: they eat more during sharp frosts than at other times. The days are short, but the shepherd should be in the field early in the morning and late at night, and leave the troughs well filled with roots and chaff when he goes away. At all times a good fall-back should be provided, but it is especially needful in wet weather, or the sheep get little chance of lying down, though rest is essential to their well-doing. The early-breeding sheep will be lambing, and should receive constant attention. It is a mistake to expect much work to be done outside the lambing-yard while the shepherd has to attend to the ewes both night and day: he should have sufficient time to look to the well-being of every ewe and lamb separately. The ewe's teats should be drawn immediately after lambing in order to see that she has plenty of milk, and that the nipple is not blocked by dirt. Otherwise the udder may get out of order, and the lamb may starve. It is best to give the ewes corn, at any rate until the lamb can eat it for itself. Where lambs are required for show purposes or for killing as fat lamb, the ewes and lambs should receive cake until dam and offspring are parted. Fattening tegs that are nearly ready for the butcher should have their allowance of corn increased gradually, but when they are being forced at high-pressure they should be constantly watched, or they may suddenly die from over-doing. Grass-fed sheep should be looked to during severe weather, and should receive an extra allowance of food, even if they do not get it at other times.

#### FEBRUARY.

The remarks made last month will apply pretty closely to this. Those animals set aside for fattening must have food calculated to fatten them in the most economical and the quickest way. This month being usually a very severe one as regards weather, it will be essential to afford protection to ewes which are expected shortly to lamb. Sheep and lambs, intended to be fattened off for market as early as possible, should also have full supplies of food given to them; oil-cake, &c., being allowed them with hay and straw chaff in proportion and quantity according to the period at which they are intended to be sold off, but it pays to give corn to all lambs. If sheep are dirty behind, all foul locks should be cut away. Sheep cannot prosper if they are lame, so every effort must be made to keep them sound on the feet, and if the shepherd's work is

so heavy that he cannot spare time for it, additional help should be given. Ewes should not be kept in the yards longer than is necessary, or foot-rot becomes inevitable. Lambs should be tailed and castrated when they are from 12 days to a fortnight old, a fine afternoon being chosen for the purpose; ram lambs must not be disturbed until the next morning, when they will get up with nothing more than a little stiffness, which will soon pass off. Be careful to supply shelter from the wind and wet in the fields. The ewes will do well on swedes at this season, but as the lambs get old enough to range and feed on green food they should be allowed to run forward on some crop which supplies them with soft tops, such as thousand-headed kale, turnips, or rape: the corn troughs should be placed outside the ewe's pen to get the lambs into the habit of running forward. Silage is very useful for ewes at this season.

#### MARCH.

Sheep generally thrive during this month if they have a plentiful supply of food, for though the weather is often cold, it is one of the dry months of the year, and as the green food is well ripened the animals make rapid progress. Thousand-headed kale should always be at hand in case the other crops fall short, but if it can be saved until next month so much the better. Mangel, being now thoroughly ripe, is very valuable. Swedes begin to lose their nutritive qualities towards the end of the month, and, as the land is required for barley, they should be fed off. The medium-early ewes—those which are expected to lamb in time for the early grass—begin to lamb, and therefore they must receive extra attention. Be careful to maintain them in condition, and to provide proper shelter for them, and otherwise treat them on the lines advised for the earlier breeders. If fat sheep are clipped before being sent to market they should be kept warm by means of coarse thick jackets; it is not only cruel to the sheep to expose them to the cold, wet, and draughts of railway trucks and markets, but it does actual harm to the meat, for if it is chilled it will not set properly—a fact well known to butchers, who regulate their prices accordingly.

#### APRIL.

This is generally a very unsettled month in the management of sheep, for it marks the change from winter methods of feeding to those of summer. It is only on the very early pastures and water meadows that any considerable growth can be relied upon, but there are seasons when there is a fair head of grass before the end of the month. These are the exceptions, and the only way to carry on sheep-farming successfully is to guard against the scarcity of food which is so frequent at this period. More money is often made in six weeks by holding over keep, and buying in sheep at this season, than in the whole of the previous six months. It must not be forgotten that the pinch comes between roots and grass, and if dry cold weather prevails during April and the early part of May, those who are overstocked will have to sell

out at a great sacrifice. Hay and straw, with additional cake or meal, will be of great assistance in tiding over the time of scarcity, but the mainstay should be found in a good store of mangel, and a large breadth of early transplanted thousand-headed kale. Rye, winter oats, vetches, and winter barley, sown as catch-crops immediately after harvest, should be coming in, and when once these are fit to stock the flock master's troubles are lightened. Lambs require fresh, sweet, soft food, but if this is scarce, a few sliced mangel or swedes, if any are left over, may be given in troughs with great advantage. Mangel are particularly valuable now, but care must be exercised in giving them to male-sheep, as they are very likely to produce inflammation of the bladder, by forming crystals, which prevent the urine from passing. They are not so dangerous to ewes, which have a larger urinary passage. The yellow leaves which have sprouted in the mangel clamp should be cut off, as they are the chief source of the danger. If the weather is warm the ticks will become troublesome, and long-woolled sheep are very liable to roll in order to rub themselves, with the result that they may become cast, and are then very soon suffocated. It is therefore necessary to keep close watch over them.

#### MAY.

May is a month when keep is generally plentiful, at any rate towards the end; the autumn sown catch-crops mentioned last month, as well as crimson clover, or "trifolium," produce bulky food, and grass is usually forward enough for stocking with sheep, as sheep pastures require keeping short, so that there may be a fresh bite constantly. The leys afford rich succulent food, but care must be taken when the sheep are first turned on them that they do not eat too ravenously, or they are very liable to burst. They should be put on with a full stomach, and be allowed to remain not more than half an hour. Dutch or white clover is the richest of all green crops, but is particularly liable to produce the condition known as hoven or tympanitis, which is due to a rapid fermentation rather than a digestion of the food, thus causing it to generate more gas than the stomach can hold. Green crops of this sort are very dangerous while frost is on them, and during windy weather. Clover intended for a seed crop should be evenly fed off, not folded, or different parts of the field will make a fresh start at different times. If a crop of Dutch clover, or of alsike, is fed off, so that the crop of seed is what is known as second-cut, the sheep should be off it by the middle of the month. The fly or sheep-maggot will begin to be troublesome in warm, moist weather, and will necessitate careful watching. If towards the middle or end of the month the weather is apparently settled for moderate warmth, washing and shearing should be done. The washing precedes the shearing or cutting by ten to fourteen days; carry out both operations with gentleness, especially the latter. The washing should be very carefully done, going to the roots of the wool tufts, and aiming at uniform purity. When one part of the fleece is well, and another badly

cleaned, the appearance, if not the quality, of the after fleece is materially affected. The same remark applies, even with greater force as regards carefulness, to the shearing or cutting. The shepherd should pay particular attention to the lambs, and on the appearance of the skit or scour, the necessity for a change of food is indicated. If rye, tares, or clover are sufficiently advanced, fold fattening and store sheep upon the crop, or feed them on cut food in yards or sheds. For food in addition to the field produce, see last month. Keep sheep off boggy land, and, if affected by the foot-rot, change them to a hard pasture, or exercise them on hard roads.

#### JUNE.

This is, as a rule, an easy month in the management of sheep, as there is nearly always a plentiful supply of fresh keep. But in arranging the crops to be fed off at this season the future must not be forgotten, as it will be necessary to dispose matters so that there will be sufficient sweet food in the months to come. Stale keep is fatal to young lambs: "stale keep" is that which has been fed off previously by sheep during the season without the intervention of a mowing. Keep may look beautifully fresh and luxuriant, and in every way tempting to sheep, but if it is soured by having been dunged upon by sheep, it is most unsafe to put young sheep on it. Ewes are stronger in their constitution, and may be put on without hurt. Sheep can follow bullocks with safety on almost all soils. The earliest cabbages may come in towards the end of the month, and are very serviceable in getting sheep up for the summer shows, or for the earlier fairs or markets. Sheep are best out of their wool at this season for all reasons. Lambs should be dipped on weaning. The fly will be troublesome. As the shepherd has a fairly easy time when the shearing is done, he should make a special effort to get rid of lameness, which can always be effected by a thorough and careful use of a sharp knife, and a moderately strong caustic. Lambs suffering from chafing between the claws require a mild caustic—a solution of vinegar and blue vitriol being sufficient, and not so punishing as many of the mixtures sold. Keep water by the sheep at all times.

#### JULY.

Cabbage, kale, and early sown rape, come in at this season, and help to provide fresh food, so that the necessity of putting lambs on stale keep may be avoided. The aftermaths will also be available as fresh food. As soon as the wool is long enough all sheep should be dipped to ward off the attacks of fly, and to check the breeding of ticks. Lamb-dipping must go on until all are finished, which will not be before they are weaned, so the later-lambing breeds will yet have to be done. Ewes should be got up in condition to receive the ram if they are required to lamb by about Christmas or the New Year. They should have been mouthed to see if they are fit to run on as breeders,

and those with broken mouths, bad udders, or which slipped their lambs before time, should have been culled out, and either fattened off or sold as culls.

#### AUGUST.

Early Tankard turnips are now in season, and with the other crops mentioned last month should carry the sheep conveniently, but it often happens that this is a trying month for the flock-master if July has been droughty. Be careful not to allow lambs to feed off stale food. In an average season a portion of the corn-stubbles will be cleared, and a useful run may be obtained on them: if there is very much corn left behind, the sheep should only be allowed on for a short time. When the stubbles are clean the sheep may be on them the greater part of the day, and go back on to grass, leys, cabbage, or turnips, as is convenient. The flies are often busy during this month, and a sharp look-out must be kept for maggots; at this season a small beetle strikes the sheep, and the maggot from this is, if anything, worse than that from the fly.

#### SEPTEMBER.

Sheep will now in many cases be drafted on to the roots, as the leys will have to be broken up for wheat. Be careful that the change to roots is not too sudden, or the sheep will receive a check, and probably some will die. Those which have been receiving early turnips, or rape, or cabbage, as part of their food, will not suffer, but those which are put upon a root diet suddenly, after receiving nothing but grass, most likely will. Unripe swedes are very dangerous, and cause great loss annually. Mangel, of course, will not be fed during autumn. Do not be too late in commencing to give dry food to the ewes, and do not let them have stale, though fresh-looking, succulent rape. More ewes are lost, or slip their lambs, because dry food is withheld too long than is generally supposed. See that the hurdles, turnip-slicers, and other implements required in the sheep-pens are put into good order before winter. Give fattening sheep nearly ready for market an increased supply of oil-cake, and a daily feed of the mixture named in the month of April. Select well-bred lambs for serving the ewes. House-fed sheep, in the fine genial weather of this month, may be turned out with advantage to fields where the grass is good. If poor, supplement with green food. If the weather is hot and the fly troublesome, attend carefully to the dipping of sheep in the fields. Where white, or stubble, or other varieties of early turnips, are supplied to the sheep, bring on the change gradually; the turnips are to be given either sliced or whole. Some prefer the latter, and nibbling at the roots, at least at first, accustoms the sheep to the harder kinds which follow at a later period.



## CHAPTER IV.

## HORSE CALENDAR.

## OCTOBER.

UNTIL recent years, October was looked upon as the hardest month for horses on the farm, but since wheat-growing has decreased, the work is not so heavy. The horses were expected to improve in condition during harvest, but they have not so good an opportunity now that they have to work the reaping-machines as when the corn was cut by hand. The advantages of autumn cultivation have become more recognised, therefore horses are not allowed to be idle, so that this is a period when horses should be receiving full rations. Though the strain from wheat-sowing is less, the spring work is correspondingly increased, so that all farmers are glad to get their work as forward as possible. Horses in work require a more concentrated food than bullocks, as their stomachs are so much smaller. The feeding must therefore be frequent, and, as horses are somewhat dainty feeders, small and frequent baits are preferable to giving the whole of a feed at once. Chopped hay or straw mixed with the corn forms the best ordinary manger-food, and oats are looked upon as the typical horse corn. Beans, however, are stronger, and where the work is very hard it is wise to mix a few with the oats. Maize is very good, but should not be given alone, as it is more suitable for making fat than muscle, and horses cannot do so much work on it as with either of the other foods mentioned. When cart-horses are in full work a stone of corn and 10 lb. of hay is about an average daily ration; but the size of the horse, the quality of the corn, the quantity of work done, and the skilfulness and carefulness of the horse-keeper, all have to be taken into consideration, and the farmer must decide for himself from the appearance of the animal whether there is need for more food or not. In many well-managed stables chaffed hay is never given, but wheat or oat-straw is chaffed, and the hay given long in the racks. Horses should be watered frequently, and not be allowed to drink too much at once. Heavy drinks of water are not good for animals when they are brought in hot from work, but if they are allowed a small quantity it will comfort them and will assist them in feeding.

Short, newly-cut chaff is very dangerous for horses, especially if it is given at once when they come in from work, as they bolt it too quickly, and are then liable to colic. New chaff is dangerous at all times, as, until the heating which always takes place during and after cutting passes away, it is tough and indigestible. Colic is perhaps more frequently caused by new tough chaff than by anything else. The old custom of walking horses through ponds before

bringing them into the stable has been proved to be the chief source of grease, therefore, on no account, no matter how muddy they may be, should this be allowed. If the animals are dirty, the thickest mud may be scraped away, and the rest rubbed off when dry. Changes of food must be made gradually. The stables should be well ventilated, but free from draughts, especially about the horse's heels; the litter should be kept fresh and sweet, and on no account left to ferment. Good grooming is essential to the general comfort of the animals, but special attention should be given to those places where the harness touches, or they will be constantly wet with perspiration, and will quickly become raw. Many young horses are broken in at this season; those  $2\frac{1}{2}$  years old, if well grown, may be put to light work for a month or two, and then turned out for the winter, so that they may be taken up again in spring, when they will be able to take full work in light implements. If they are to be turned up in winter it is best not to accustom them to a warm stable, but merely to a comfortable yard, or they are likely to suffer when the change is effected on the eve of winter. Backward foals should be weaned. They will do best if allowed a run on grass at all seasons, but they should have a shed where they can be fed, and where they can get out of the wet. Always keep salt by horses: if it is not mixed with the chaff, a lump should be placed where they can lick it as they wish.

#### NOVEMBER.

Autumn cultivation can rarely be carried on after October, and as wheat seeding should be nearly finished, there is not much to do on the land beyond ploughing. The days are short and the horses are not required to do extra long days' work, and will therefore need nothing beyond ordinary rations; still, as the fallow ploughings are generally deep and heavy it is a mistake to keep horses short of food, for stinting in food undermines their constitution far more than is generally recognised. It is a common practice in some districts not to curtail the corn, but to substitute pea-haulm, and barley-cavings if there is a fair amount of clover in them, for the hay, and if a few roots are given it is with satisfactory results. Be careful with in-foal mares that they are not put to shaft work, or allowed to back, as actions such as these frequently cause them to slip their foals. Young horses which have been used during wheat-seeding may be turned loose in pastures, or kept in yards: take care that there is no low shed against which they might knock their heads, as more poll-evil results from this than from all other causes put together. Young colts yarded during winter may receive cavings, rough but sweet hay, a few roots, or any other convenient coarse food, and will grow all the better for a little corn in addition, but, if they are not wanted for show purposes, from a quarter to half a peck of oats is sufficient. If they are being forced they must be watched to see that they do not get humoury, and an occasional mild ball, or opening food, should be given. Keep strict watch on the men tending horses lest they use arsenic or other violent drugs, as the practice of drugging is carried on to an alarming extent.

## DECEMBER.

Little needs to be added to the instructions under last month. If the weather is in its usual condition, the work of the horses may be said to be reduced to a minimum, field work being almost wholly at a stand-still, save that of carting manure to the various fields to which it is to be applied, and market carting. Although the heavy feeding required when the animals are in full work is not necessary now, and would be injurious if permitted, their proper condition must be maintained by judicious supplies of nutritious food; the period is rapidly approaching in which they will be called upon to do full duty. Much damage, however, is done by allowing horses to feed too freely when they are idle; this is true at all times, but is particularly applicable to Sundays, for mild colic so often results that in some districts it is not uncommon to hear the term "Monday morning" used to denote the little upsetting of the digestive organs which so frequently occurs after an idle day: if the mild attack is not attended to it may become serious. Give changes or variety in food, and see to the thorough cleanliness of the stable and all its belongings. Although not always wet, groom carefully and regularly, as this has a most beneficial action on the skin and its secretions. If the weather is very severe give the horses freshly-pumped water, rather than that which has been allowed to get frozen.

## JANUARY.

This is the coldest month of the year, and severe frosts may be expected which will bind the land too firmly for the plough to face; when this is the case carting is the only work which can be done, so it is usually looked upon as an easy time for horses. The horse food should therefore be regulated accordingly, but as the heavy season of spring work will soon be coming on, it is a mistake to let them fall away in condition; in fact, the endeavour should be to improve them, for the coming four or five months are the hardest in the horses' year. The general rules mentioned in the foregoing months are applicable to this.

## FEBRUARY.

As the weather becomes more "open," the amount of field work is increased in proportion, and in proportion likewise the food supply is increased also; this being chiefly in the form of larger allowances of corn. The hay supplied should be of the best quality. Carrots should form part of the daily ration, care being taken to have enough of these grown to last the whole season. Parsnips are as good as carrots for horses, and are as well liked by them, while they possess the great advantage of being so hardy that they may be left in the ground if need be all the winter, and taken up as wanted; whilst they keep so well that there is no difficulty in having a supply "all the year round." It is a most valuable root, and both it and carrots keep the horse in capital condition. Mangel is also very useful, and is now acquiring condition suitable for feeding. The recommenda-

tions as to general care of the animals, given under the months of October and November, apply equally well to the present month, and should be as carefully attended to. As in the case of cattle, strict attention should always be paid to the general health of the horses, especially as regards the condition of the bowels. In truth greater attention is required in their case than in that of cattle, as horses are subject to a wider range of complaints and diseases, and are much more liable to be attacked by them. Attend therefore to the slightest symptoms of anything "being wrong," and do not rest satisfied with the idea too prevalent that "it will soon be all right." Diseases as a rule do not pass away without attention being paid to them; but rather go on quickly from bad to worse. Whenever horses have been unwell it is a mistake to put them into full work too soon. They should be fed on the most easily digested foods, an occasional bran mash being very useful, as indeed it is at all seasons.

#### MARCH.

Work being now, under usual circumstances, "in full swing," as the phrase is in the fields, preparing the land for spring crops, and getting in such as are yet to be sown, and the horses therefore in constant work, they must not be stinted in their feeding, oats and corn again forming the staple, as the most sustaining of all the foods given to them. Beans are more nutritious, but their fault is a tendency to make the animals constipated. This with some horses is so decided an effect that they cannot be given to them, or ought not, unless associated with some food having a corrective or opposite tendency. Given with a full allowance of oats, two bushels a week or thereabout, they will suit the generality of animals, especially if carrots, some twenty to thirty pounds daily, be given with them. A warm mash at night has a good influence upon the bowels. Feed regularly, and with short intervals between the feeds. In wet weather rub down with dry straw, and have the lower extremities thoroughly clean and dry, and the animals comfortable in every way before bedding them. There is much to be done in finding out the likes and dislikes of animals as regards food, and horses are no exception to this common-sense rule.

#### APRIL.

Hard work being still more the rule this month than even last month, increased food rations, both in the bulk and the quality of the materials of which they are composed, must be the rule also. This does not, however, mean, as some feeders injudiciously think it does, heavy feedings at each "meal." On the contrary, remembering what we have before said as to the smallness of the stomach and digestive organs of the horse, the meals must be comparatively light, and the intervals between them correspondingly short. They should be proportioned to the "yoking," or periods during which the animals are at work, the two being arranged accordingly. The system universally

followed in Scotland as regards the intervals between the feeding times of the ploughmen, viz., four hours, suits admirably for the animals, this being the longest period during which they should be allowed to fast and work. There is no more mistaken economy, if the term be allowable, than that of long "yokings," or working periods, for horses; under judiciously short ones they will do more work at less cost of food and wear and tear of the system. If long yokings are practised greater pains must be taken in the stables, and the baiting times must be longer. In some parts of the Midlands one long yoke is the custom, and answers very well, but the horses are brought into the stable at 2 p.m., and are baited until 7 p.m., then racked up for the night; in the morning the horsekeeper is in the stable by 4 o'clock, and baits them until they are turned out to work at 6 o'clock: in this way the horses get up a reserve of strength, and a long rest, and are able to do a hard turn at work without injury. For remarks on the general system of feeding, grooming, stable management and health, see months of October and November.

The green forage food now ready, as winter rape, rye, and vetches, cut along with the straw, and mixed with oats and beans, crushed and ground into meal, will form a capital food, and it will, given judiciously, accustom the horses to the change from the winter to the summer green feeding. A little salt should in all cases be added to the mixture. If vetches or tares be the cut green food, they ought to be allowed to lie for a short period, as, if given fresh cut, they are apt to act somewhat strongly on the bowels.

Mares about the foaling time should have shorter periods of work, but are best kept in moderate work close up to the time of foaling. The food given at this time must be nutritious, to meet the demand on the system. For ten days or a fortnight before the "note," or calculated or recorded time for foaling, particular attention must be paid to the condition of the bowels, it being essential to keep them gently open. Neglect of this has resulted in the loss, through subsequent milk fever, of many a valuable animal. Young colts under training for the "yoke" should be gradually accustomed to the work, gentle persuasive tenderness being the rule. If men are seen or known to be in the habit of breaking in colts under a different system, they should be warned for the first offence, and made distinctly to understand that the second offence brings "dismissal without appeal." A rule of this kind has been known to work where all others have failed, and failure where such valuable stock is concerned is a great misfortune. The work of young colts should be easy at first, and under it they should be well fed and carefully watched and attended to. On farms where early foals are bred a great many mares are put to the stallion at this time. A sound, well-bred horse should be selected; this is now comparatively easy in most districts, as the breeding of good cart-horses has developed greatly during the last few years.

## MAY.

For remarks and recommendations as to foods, feeding, and general care and management see last month, to which the following may be given as supplementary. If carrots are still to be had, or parsnips, they should form part of the daily food, as also green cut forage. Where grass is cut fresh to add to the food, it should not be mown till the dew is off the ground, or till the rain has dried up when rain has fallen some time before. The work being this month unusually heavy in order to overtake the "turnip brake," or to get the turnip crops in, the food supplied must be abundant in quantity and good in quality, corn or oats being the staple. If the horses should show signs of shivering after wet at any time, give them a warm mash and a small dose of medicine. This is perhaps the month when the greater number of mares are put to the horse, and it is a very good time for the purpose. Be careful in the selection of a stallion to obtain one which is sound, and suitable for the mare. Also be specially on the alert to breed for good feet and legs, with plenty of flat-bone—the body can be made up, but the legs and feet cannot be, and a good top is worthless if it is not carried on sound legs.

## JUNE.

As turnip-sowing is still going on, and much heavy work remains to be done, as in hay harvesting, food must be correspondingly kept up; for remarks on which see the last two months. For evening meals, excellent mixtures can be made with cut green food and crushed oats and bean meal. Maize or Indian corn is often used; it gives a capital "coat," glossy and healthy looking, and it is a nutritious food; but great care, especially with some animals, is requisite in using it, as it is apt to soften the liver. Young colts not worked during the day may be pastured at night, but in wet weather they will be better kept in "hammels" or in courts with sheltered sheds; so also with horses not worked during the day. Mares may still be put to the horse; in districts where there is very heavy spring work it is often preferable to breed late as the mares can be ill-spared from the teams until the greater part of the preparation for root crops is completed. The foal will probably not make quite so good a horse, but the value of a horse at this season is as great per day as it is per week at some periods of the year. If mares with foals are worked, the foals should not be allowed to suckle until the mares have been in the stable long enough to get cool, or the foal may scour, and even die from the effects of the heated milk.

## JULY.

The work of this month is much less severe upon the horses than that of the preceding month, but as they have in prospect—in early districts—the severe labour of the reaping machine at the end of it, their strength to meet it must be kept up by giving them good supplies

of food; and there is still considerable work to be done in the way of odd jobs, so that they must not be let down. See preceding months of April, May, and June as to details of general care, management, and modes of feeding. But if the work is light a portion of the corn may be taken off, though, at the present (1908) low prices of feeding-stuffs, the economy is perhaps doubtful. The heavy work of the previous months has generally been so severe that the horses have got low in condition, and this affords a good opportunity of getting them up again. If flies are troublesome a little paraffin sprayed into the ears, and sprinkled above the muzzle, will afford protection for two or three days. Those animals not in full work may be pastured, care however being taken to keep them from the torment of the "plague of flies," of which some farmers think very little, but which others, wiser in their day and generation, know have a most prejudicial influence upon the health and condition. Such evils can be prevented by the provision of "shelter sheds," as to which we cannot write too often, or urge upon the attention of stock-keepers too strongly. Taking everything into consideration, the advantages arising from the system of stabling or yard-feeding and sheltering of horses immensely outweigh those from open-field pasturing, even with the addition of shelter sheds.

## AUGUST.

The work for this month, including as it does reaping of the cereals, &c., is severe upon the horses, as anyone may see who watches even for an hour or two their work in the field on a hot day with a heavy crop. The ploughing also of lands which have been occupied by the wheat crops just reaped, adds to their labour; so that altogether the horses have their fair share of work to do, and require correspondingly good supplies of food. As the working days are long the horse-keeper should be in the stable extra early to commence the morning baiting. A great many foals are weaned at this season; give them good food at first so that they do not get low in condition. For remarks on the general care, feeding, and management, see preceding months.

## SEPTEMBER.

Autumn cultivation is now practised so much that it is necessary to keep up the condition of the horses by liberal feeding. Special precautions should be taken with regard to the health of the animals, as this is a period of the year at which they are more than usually liable to attacks of various diseases. Attention to the condition of the bowels is found to ward off many an attack which might otherwise prove difficult to deal with, if not in some instances turn out fatal. Exposing the animals to night air must now be absolutely given up as a practice wholly wrong. Continue to give green food as long as the clover and vetches last, after which cabbage should be supplied.

## CHAPTER V.

## PIG CALENDAR.\*

## OCTOBER.

**P**UT up store pigs which are advanced enough to commence fattening; feed them liberally on the best food at command, giving them corn, peas, beans, and hard grains, with the usual liquid foods, as dairy refuse, mashes, &c. Barley is the most perfect pig food, and produces the highest quality of meat. It is best to grind the meal as fine as possible.

Fattening pigs, nearly ready for the butcher, should be finished off with regular feeds of thick meal mashes, barley-meal being reckoned first, and oatmeal next in value; a little bean meal will give firmness to the flesh; maize meal is very useful to mix, in small quantities, with other foods, but should not be given by itself. Keep store pigs regularly and steadily improving, and pick out the best for future fattening; sell off, if desirable, such of the others as can be dispensed with. Give young pigs, of the last farrowing of the season, as much of the best part of the dairy produce as can be spared from the feeding of the fattening hogs, and of such sows as may have litters. Mix some meal with the milk. An occasional feed of cabbages may be given them. These with carrots, mangel, and turnips, will form an excellent food for store pigs. Feed sows with litters on thin mashes at first; later they should have more nutritious food, as the young pigs soon require a liberal supply of milk. In all cases the sties and feeding-troughs must be kept scrupulously clean, and the bedding of wheat straw frequently removed, to avoid the accumulation of dung.

## NOVEMBER.

Pigs born this month are not, as a rule, profitable, unless they are very warmly housed; nor are very young pigs if they have the run of the yards, for which purpose fairly strong stores should be selected. It is a good time to put sows and yilts to the boar, as they will farrow at the best season—February or March. Of course, when sows have once pigged they must be put to the boar again as soon as they will take him, or time is lost; but the yilts born in February, March, or April, might be selected for breeding, as they are at a good age in November for being put to the hog. No yilt should be bred from which has less than twelve teats, or the litters cannot be big, and they may be small. Pigs are most profitable when they obtain a large portion of their food by scavenging about the yards, and preventing waste; the rest of their food can be made up by using the offal corn, and by giving them roots, and any wash that may be collected in the hog-tub. Attend to the careful bedding of all the stock, and to the thorough

\* The pig calendar is continued, with alterations which bring it as much as possible up to date; but the great changes wrought in the entire system of pig-keeping by the general adoption of the mild system of bacon curing and by a greatly increased consumption of small pork at all seasons render it increasingly difficult to apportion to periods the work in the pig-yard. The breeding and feeding of pigs is now a continuous pursuit, the sows being timed to farrow during all the months of the year save during the latter part of the month of October, the whole of November, and the early portion of December.



cleansing of sties, troughs, and the bodies of the animals; especially in the latter case to fattened pigs about to be sold, and sows with litters.

## DECEMBER.

The general treatment of all classes of swine stock is very much the same as described under last month; but the more severe the weather, the less desirable is it that cold food be given them. Notwithstanding popular opinion to the contrary, there is no animal of the farm so sensitive to cold as the pig; no other stock suffer so much, or deteriorate so greatly under its influence. Hence, fresh warm bedding should be provided at all times.

## JANUARY.

Keep pigs fattening for bacon well and regularly fed. For this purpose, nothing is better than barley-meal, with a few sharps, mixed with the wash from the hog-tub, which generally contains skim-milk or other dairy refuse, and odds and ends from the house. A few roots may also be given. Where the accommodation permits it, some or all of the food may be mixed with warm water, and if the weather is cold this is preferable. Young store pigs are all the better for warm food at this season. The stronger stores will soon be fit for fattening, and should receive more meal than hitherto. Sows which have been put to the boar for spring farrowing must be kept in good condition, with ample supplies of nearly all the kinds of food which the regular systems of cropping, supposed to be carried out on the farm, can afford. But the sows must not be allowed to get fat or they will grow lazy, and will probably lie on their young and kill them soon after farrowing; there is greater risk, too, at the time of farrowing, as the sow cannot bring forth her young so easily.

## FEBRUARY.

Sows expected to farrow at the end of this month or in March must be carefully watched, special attention being paid to the condition of their bowels, to avoid undue constipation, which may be said to be the foundation or cause of nearly all complaints. Put up for fattening such of the store pigs as may be ready. Commence administering the richer foods, now to be given, gradually increasing as the pigs get near the period of finishing off. The food should consist of warm mashes, and of meal and sharps. The mashes should not be too thin, but rather thick; and, as the fattening proceeds, the meal, which should form the chief constituent, should be increased in quantity. Potatoes also may be used for mashes, and now and then a handful of one or other of the best artificial or condimental foods may be given with advantage. Where there is no cooking apparatus the food must be given mixed with water, or wash, and it is more digestible if the meal is allowed to soak for a few hours before being served; there are not a few pig-feeders who prefer this system to cooking. Salt is said by some to act prejudicially, if not indeed, as others maintain, as a direct poison; this

may be the case when given in excess, but we have always found that when given moderately, that is, in quantity sufficient merely to flavour the food and take off its natural insipidity, the pigs have always relished the food more keenly, and have at all events appeared to thrive exceedingly well. Another food, if it can be so called, is coals, of which all pigs are exceedingly fond; they eat them with such avidity as to make it appear that they are essential to the maintenance of their good condition. Cinders are sometimes used, but coals appear to be best, and should be given in smallish pieces, about the size of an egg; too much should be avoided. Sulphur should be given in occasional small doses to pigs.

#### MARCH.

Make preparation for the farrowing of sows. Have the sty thoroughly cleaned out, and only leave in it a very small quantity of litter or the little pigs may be smothered. The sty must be kept scrupulously sweet and clean whenever young pigs occupy it: it is necessary for all pigs to be clean, but little pigs must have a sweet sty if they are to be kept in good health and steady growth. Keep the sow on thin food at first, but gradually increase its consistency as the young pigs require more milk. Fix a board at the sides of the sty after the manner of a lean-to or shed roof, leaving a space below it where the young pigs may run, as the sow, especially if large and heavy, is apt to overlay them, crushing them up against the walls, for pigs in lying down prefer to have something solid to bear upon. Equal protection may be afforded to the young pigs by a low rail, about a foot above the ground, and a foot or a foot-and-a-half from the wall of the sty. When the sow is about to farrow, provide the sty with a hamper, into which the young pigs should be put as they are born, and there kept till the labour of the sow is completed; the pigs must then be returned to the sow. But if there be any wet litter in the sty, it should be removed before the young pigs are put back to the sow, and replaced by a small quantity of dry straw. Watch the sow closely, lest she show a desire to eat her pigs. If the teeth of the newly-born pigs are broken off, it is seldom that the sow attempts to eat her young. But unless the animal shows a disposition to commit the offence, this somewhat barbarous treatment is not to be recommended. The treatment of other classes of pigs is the same as that for the last two or three months.

#### APRIL.

Pay particular attention to farrowing sows and their litters. The latter may receive, with advantage, at the age of twenty days, and for some time after, a separate allowance at least once daily of warm milk thickened with a little meal. Pigs sometimes go "off their feet" if they are too highly fed, so the supply must not be too liberal while they are sucking their mothers. Skim milk must be given sparingly at this time as it is a food rich in nitrogen, and the disease is really paralysis

caused by the presence of too much nitrogen in the blood; if milk is given, the meal with it should be starchy, rather than nitrogenous. If milk is not given, whole wheat may be used. Give the sows warm mash moderately liquid, and attend carefully to their bedding, seeing that it is dry and warm. Wean the pigs when about six to eight weeks old: the pigs should be operated upon a week before, so that any little check they might receive may be counteracted by the support they derive from their mother's milk. Bring on store pigs progressively into a condition fit for fattening. Every variety of food will be taken by them if they are of a good breed, and their food is properly prepared. Finish off fattening pigs ready for sale; for treatment of others, in progressive stages, see previous months.

## MAY.

Put the sow to the boar as soon as she will take him, which is generally about three days after her litter is taken from her. She will breed more freely if she is allowed plenty of exercise, and the best place for her is a grass-run, but care must be taken that the fences are good, or she will be a constant source of anxiety. Some sows will occasionally be in heat during the times the pigs are suckling, but it is best not to let them have the boar. Attend to farrow sows and young pigs—see last month. Give store pigs, and those put up for fattening, feeds of such green forage as may be sufficiently advanced for cutting; as tares, rye, &c., with potatoes and roots to form the bulk of their food. Give young pigs, after being weaned, feeds of dairy produce, mixed with meals of various kinds.

## JUNE.

Attend to sows about to farrow and to those which have litters, details of treatment of which will be found under March. Give store-pigs cut green food in their yards, which should be supplied with abundant litter, so as to produce plenty of manure, and keep pushing them on progressively into good condition, with a view to drafting them into the fattening sties. Provide a small field, near the steading, in which pigs can be put for some hours a day, thereby avoiding exposure to strong sun, which blisters and inflames the hides. Brewers' grains should be stored in pits for winter use during this month, and whenever there is a surplus supply of keep.

## JULY.

Store pigs can be kept cheaply at this season as there is always a good supply of green food, such as clover, vetches, or cabbage which can be brought into the yards for them. They require a liberal amount of wash in hot weather, and to this can be added meal, which should be regulated by the progress they are desired to make. In-pig sows should be treated in the same manner, allowing, as mentioned before, a good grass-run. A pool, to afford them a chance of wallowing, is a source of comfort to them in hot weather, but shade is essential.

## AUGUST.

Store pigs may be either turned out to the stubbles of corn fields which are harvested, or fed in yards, as some prefer, for the more economical saving of the manure. If the latter, they must be fed on cut forage, brewers' and distillers' wash, and dairy refuse, cabbage, the sweepings of corn-carts, or any offal that may be on the place. Get in a good store of brewers' grains as they are cheaper than in winter, and if well trodden into pits will keep sweet for months.

## SEPTEMBER.

Finish off fattening pigs, within three weeks of sale, with barley-meal, oat-meal, maize-meal, or any cheap yet nutritious food that may be convenient. Pea-meal gives pigs a firm touch, and a little may be used just before sale, but if it is used freely throughout the fattening period the pork will be too hard. As the autumn advances the demand for fresh pork continues to increase. The custom is tending towards the production of small meat, pigs weighing eight or nine score pounds being considered the most useful size for eating fresh; and although bacon pigs are run on to a greater size, yet coarse bacon is in disfavour, quality being the first thing to aim at, which is not compatible with very big and heavy pigs. As the rest of the stock come in, the pigs will be brought into the yards also, and, with the exception of a little stubble-running, or acorn-picking, will commence their winter in the yards; green food, such as tares, cabbage, or clover should be given when convenient. If the sties have not been whitewashed and thoroughly prepared for the winter, no time should be lost in attending to these details.

## CHAPTER VI.

## POULTRY CALENDAR.

## OCTOBER.

**C**LEAN thoroughly the hen-houses, &c., and repair all fittings out of order. Take up the old, and lay down new floors, if of earth; and make and put everything in order for the coming winter months. Pay attention to the prevention of damp, looking specially to the condition of the roof, that no drip be coming through it. It is desirable to ensure that the houses are perfectly watertight, and that the ground outside slopes away from the house, so as to prevent rain running inward. It is an excellent plan to make a water course a foot from the walls.

A most important point is to clear off all surplus stock. At this season very few eggs are obtained unless special pains are taken to get them, as the older fowls have not got over their moult. The pullets are the most reliable layers now, but good feeding is particularly necessary for the production of eggs, and a marked increase is always the result of warm food, especially from now until warm weather again sets in. Be sure at all times to keep a plentiful supply of sharp grit and lime or chalk within reach of the fowls. Let the feeding be regular, the ventilation free but not draughty, and the water supply fresh and plentiful.

#### NOVEMBER.

The work of this month is still more easy than that of the last, being confined chiefly to keeping the houses in order, and seeing that the inmates are comfortable. Pay special attention to the birds set aside for fattening, arranging them according to age and condition; so that they will come in ready for market in a series or successional order. Early spring chickens are perhaps the most remunerative, and those hatched now will come to profit when game is out of season, therefore, those who possess incubators do well by getting some good broods hatched. They will require careful management, but as they pay for it this should not be objected to; beyond being kept dry, and in a healthy run, there is really very little more trouble in getting them through the winter months than through the spring. A large roomy chicken-house is a good investment.

#### DECEMBER.

The fattening of the birds set aside for the Christmas market must now receive its final attention, so that the birds may be finished off in as plump and saleable a condition as possible. To fatten quickly, the birds should be confined in a comfortable shed, to which very little light is admitted, and the last stage of what may be called extreme fattening should not exceed twelve or fourteen days, over-fattened fowls being liable to inflammation and other complaints. They will do best if placed in fattening-pens or coops where they cannot take much exercise. Their food may be composed chiefly of a thin paste made from ground oats, mixed with soured skim milk and a small quantity of suet or fat. Good clean kitchen stuff, scraps of meat, &c., may be given with advantage to the fowls. Meaty bones will engage their attention for many an hour, and will form, moreover, nutritious food. See to the supply of clean water and of old mortar, egg shells, gravel, or sand, for the fowls to peck at.

#### JANUARY.

Attend to the condition of the houses, the supply of water and other necessaries. Comparatively few hens will be laying now, as a general rule, but much depends upon the breed, and the system of feeding, warm food being especially effective at this season. The great point to be aimed at is to keep the birds in a *warm and thoroughly dry* house, on regularly administered food calculated to maintain the heat of the

body. Oats are excellent food, and should be given the birds before roosting. Another point is to keep the birds free from vermin, for which purpose dust baths should be thoroughly supplied with dust. Change frequently the materials of which the nests are composed. Fumigate the houses when empty with brimstone, and sprinkle a little flowers of sulphur in the nests. To keep up the succession of broods, hens selected for setting should be induced to become broody by the end of the month for the earliest hatches. A few ducks' eggs may be expected, and these should be placed under a hen for producing the earliest broods. In the districts where early ducklings are raised, ducks' eggs are often worth 6*d.* a piece at this period. The duckling raisers prefer hens to incubators. Get the guinea-fowls in good condition.

#### FEBRUARY.

Eggs generally become more plentiful at this season, and every effort should be made to hatch out early broods as they are in all ways the most valuable. The nests should be made in quiet places, and the hens should only be disturbed at feeding times. If the hens cannot get to damp places, the eggs should be moistened; this is particularly necessary in the case of ducks' eggs. If sitting-hens are not available in sufficient numbers, incubators should be used. Guinea-fowls are now in season, and, as game is not obtainable, are very valuable. A most important point, at this period of the year, is to see that the cock birds are healthy and well fed. Sometimes it is necessary to give them food by themselves.

#### MARCH.

The hard work of the poultry yard may be said to have commenced this month, hens rapidly becoming broody. Towards the end of the month several hatches may be expected. For all the details concerning the setting of hens, the feeding and care of chickens, and the management of fattening fowls and laying hens, see Text. In setting ducks' eggs for hatches, the broods of which are to be reared for sale as food, select those that are the produce of Aylesbury ducks and Rouen drakes. Watch the turkeys so that, in case they commence laying, their eggs may be found; this is necessary as they often roam far and lay their eggs in unexpected places at a distance from the homestead. The early hatches are best; the first lot of eggs should be placed under hens, and the turkeys will keep on laying. The same applies to guinea-fowls. Young turkeys are very tender and must be carefully managed. Goslings are much more easily reared, as they may be left to the care of the geese, which make excellent and careful mothers. They must have access to a pond and a run of grass.

#### APRIL.

The work of this month is chiefly connected with the care of broody hens and young chickens; the latter must be specially looked after. See to laying hens, which will now be laying abundantly. Set turkeys

with eggs, not exceeding fifteen in number, for the birds' earlier hatches (see last month). Feed young goslings with soft food, and let ducks of the first hatch have access to the pond when the weather is warm; otherwise they are best kept away from it.

## MAY.

The work of this month so closely resembles that of April, that little need be said in addition. Eggs are very cheap now, and a head of poultry can be got up very easily as there is not so much danger from cold, and they thrive well. Poultry are all the better for a run on grass, but young birds should be kept off the pastures when these are wet with dew or rain. When the stock is turned out of the yards there is but little food for the fowls to pick up in them, a point which must be borne in mind throughout the summer.

## JUNE.

The chickens of the second and third broods being nearly ready for market, set them up in coops for the last fortnight before despatching them for sale, in order to finish them off with abundant supplies of fattening food. The younger hatches of chickens, if kept on a small run, should be kept apart from those hatched earlier in the year, or they will not get their proper share of food. Specially good birds should be selected to breed from.

## JULY.

Where good grass runs are provided for the birds of all classes, especially if they have access to fields, they will almost keep themselves. Even in such circumstances, however, give them morning and evening feeds in the yard. The evening feeds should not be composed of too heavy food as it causes indigestion.

## AUGUST.

The remarks made last month will apply almost to this. Towards the end of the month corn will be coming in from the fields, so that a certain amount of loose grain will be scattered about the homesteads, and this will afford welcome food for the poultry, especially if there are not many worms or insects obtainable. Geese should be turned out on the stubbles to forage. Eggs being abundant and cheap, preserve some for family use, and for winter sale, but as preserved eggs only. Continue the selection of breeds as in last month. Sell off or kill the cockerels, keeping the best for breeding purposes at the rate of one bird to six or eight hens.

## SEPTEMBER.

On most farms a considerable portion of the poultry, having benefited from the pickings in the stackyards, are in good condition for

sale, and all those in marketable condition should be got rid of, for though they may fetch a few pence less than they might at Christmas there will really be greater profit. If the geese cannot get sufficient corn on the stubbles they should receive some when they are brought in, so that they may be in good condition by Michaelmas. Be careful that all poultry are trained when young to come into the poultry-house at night, or much trouble in this respect will result afterwards.

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## CHAPTER VII.

### SUMMARY CALENDAR OF GENERAL FARM WORK.

#### OCTOBER.

**H**IRE and stock farms. Insure property from fire without delay; Michaelmas policies must be renewed by the 14th inst. Hire yearly servants. Sow winter tares, if they have not been already sown in September. Winter beans and seed wheat may also be sown. Dig up and carry root crops, and protect them from frosts. Dig potatoes. Manure grass lands. Sow wheat. Continue autumn cultivations while the weather is favourable, but do not get too much work in hand at once. Transplant cabbage from seed beds sown in August. Lay up fallows. Manure and plough for peas, beans, barley, and oats. Scour out drains, ditches, and other watercourses. Attend to outlets of drains, clearing them if they have become blocked; a very important operation, too often neglected. Flood water meadows. Repair the fences. Get the straw-yards, cow-houses, and stables ready for the cattle, as this is the last month for their continuing abroad. Put fattening beasts to cabbage, carrots, or turnips; cows in milk to cabbage, in a separate yard; dry cows to chaff; fattening sheep to turnips; and the teams to chaff, hay, mixed fodder, or other dry food. Put rams to ewes. Wean foals. Plant trees. Destroy weeds. Plant quicksets. October, it should be remarked, is one of the busiest seasons in the whole year, and comprises that period of good or tolerable weather which usually occurs before most field business is stopped by rain, snow, or frost; hence it may not infrequently happen that work, here noted as requiring to be done, must be finished in the following month. Whatever operations, therefore, the farmer cannot execute in October, he must finish as early as he can in November.

#### NOVEMBER.

Continue ploughing fallows; and endeavour to close wheat-sowing within the early part of the month, at the very latest. Continue



flooding water meadows. Cart dung in favourable weather. Destroy ant and mole hills, and level pastures. Repair fences, and continue to scour out ditches. Under-drain wet lands. Cut down wood. Buy in strong store-pigs for the yard, and put up bacon hogs to fatten. Dispose of fat beasts and swine already fattened off for curing bacon. Attend to the feeding, warmth, and comfort of cattle. Select young calves to breed from. Keep fattening sheep on turnips or cabbage, with hay, and lean ones on the remnant of summer grass, and on sheep-walks. Stack and preserve carrots, if not already done, and turnips from frost. Get in and store swedes. Pit potatoes, if not already done. When ploughing for spring crops the subsoil plough may be used with advantage to pulverise and break up the subsoil, and render the land more permeable to the atmosphere and to moisture. Be careful to keep water gutters cleaned out. Thresh corn as required.

## DECEMBER.

Do not work the land in bad weather, but lose no opportunity when it is fine to break up stubbles not already moved. Keep the ploughing up close behind the sheep. Prepare sheep yards for early-lambing ewes. Carefully attend to the littering, cleanliness, and ventilation of the farm-yards, cow-houses, stables, and cattle-sheds. See that implements are placed under cover. Chain-harrow pastures and meadows. Collect turf, cart earth, marl, or clay from ditches, banks, or pits, to form temporary foundations for cattle-yards, and to absorb the liquid manure. Attend particularly to ewes near the time of lambing, and litter them if kept in folds, and feed them well. Give fat sheep some hay. Well litter swine. Flood the water meadows. Clean out ditches. Put boars to sows for spring litters. In preparation for spring crops, finish any ploughing left undone in October or November. Settle quarterly bills and farm accounts.

## JANUARY.

Still greater care is required in working land if the weather is wet, for as the winter advances there are fewer chances for frost to mellow it. Take advantage of light frosts for ploughing up sheep-pens which have been much trodden by sheep. Carefully watch cows near the time of calving, and allow them some succulent food, besides hay. Take care of ewes that have already lambed, or are near the time of lambing; shelter them as much as possible; if still kept on turnips, allow them also a small quantity of hay; cabbage will make an excellent food for them. Fatten beasts. Marl lands. Cart the mud from ponds and the scrapings of ditches. Repair fences and hedges. Drain wet lands. Examine water-furrows and water meadows. House weanling calves and foals. Cut and spread ant-hills. Finish killing and curing bacon, if not already done. Burn lime. Cart manure, especially on to grass land. Sow soot or lime over wheat land if the slugs attack it.

## FEBRUARY.

Arrears of ploughing for spring crops may be cleared up as far as possible. If the month proves dry enough, the sowing of beans, hardy peas, and spring tares, should be carried on, and when the land will work well, spring wheat, barley, and oats also may be sown. Attend once more to outlets of drains. Manure and roll grass lands. Attend to the cleanliness and warmth of lambing ewes, and do not keep them in damp or wet yards. Give sheep oil-cake, &c. Attend to water meadows. If not attended to sooner, see that implements are in good order for the work of the season

## MARCH.

Feed off the roots on land intended for barley, or it will be late for sowing by the time the seed-bed is prepared. Turn sheep into old watered meadows. Shut up meadows and pastures for grass crops. Watch cows near calving and ewes near lambing. Geld lambs. Finish sowing beans, peas, and oats; and sow white oats and barley, flax and hemp. Top-dress wheat with soot, ashes, lime, or salt, and nitrate of soda if required. Watch sows about to farrow, especially young ones. Buy lean beasts for grazing. Dispose of fat beasts and wethers fattened in winter. This is the principal month for sowing spring corn crops when the land is in good condition, including late peas and beans, the spring varieties of rye and tares, barley, oats; also parsnips, early carrots, onions, lucerne, and sainfoin. Clovers and other seeds may be sown in corn crops towards the end of the month, or left to be done in April. Potatoes may be planted when a good tilth can be made.

## APRIL.

Finish the sowing of spring corn and seeds and the planting of potatoes as soon as practicable, and sow mangel on well-prepared land. Attend to cows calving and ewes lambing. Have a careful eye to the sheep-keep, as it is often a hard matter to carry sheep during the coming month before the pastures are ready. Castrate lambs and pigs. Soil cattle. Sell fat lambs and porkers. Put stallions to mares. Turn cattle into pastures, if the season be forward. Put sheep into water-meadows. Attend to mares foaling. Destroy ant-hills and mole-hills. Roll and chain-harrow grass land. Horse- or hand-hoeing should be done in early crops.

## MAY.

Put bulls to cows and boars to sows. Wean young pigs of the first litter. Sow buckwheat, lucerne, sainfoin, and Swedish turnips for winter use. Clear up arrears of April sowing. Watch mares foaling. Early this month cross-work fallows. Hoe early planted potatoes and wheat; clean drilled peas and beans, and finish planting potatoes early

in the month. Turn cattle into pastures. Graze pastures laid to rest at Candlemas, and shut up such as are to be mown at Midsummer. Feed horned cattle, if needful. Fold sheep; and examine them, lest they be fly-struck. Destroy moles and other vermin. Drain swampy and boggy land. Cut, dry, and house turf for winter fuel. Mow tares and lucerne for green fodder. Attend carefully to the dairy. Commence sowing swedes, and finish mangel seeding. Sow late carrots. Spray young corn crops to destroy charlock.

## JUNE.

Sow swedes, rape, kale, and common turnips; hoe mangel, also carrots and swedes, already in rough leaf, if the weather be favourable. Weed corn crops. Attend to the cabbage crops. Transplant cabbage and kale. Cart manure to fields in which it will be required for application in the autumn. Wean lambs. Wash and shear sheep. Dispose of fat stock. Soil cattle. Clean out ponds, if dry, and prepare the mud for manure. Repair mowers. Mow grass, rye-grass, clover, and sainfoin. Continue to get in turf for winter fuel. Cut down weeds in hedges. Spray potato crops with *bowillie bordelaise*.

## JULY.

Finish the weaning of lambs. Shear sheep, if the month of June has been too wet or cool. Hand-hoe or horse-hoe root crops and potatoes. Sow cole-seed. Weed cabbage crops, and early this month hoe those planted in June. Hoe carrots and parsnips. Finish mowing grass lands. Mow lucerne. Finish haymaking. Hoe lucerne. Cut early peas and rye, if ready. Continue clearing out ponds, if dry, and prepare the mud for manure. Reap winter oats about the end of this month. Plough fallows, and cart out chalk, marl, and earthy manures. Shut up rowen, or aftermath. Clear out the barns. Prepare the stack yards, &c. Look to the waggons. In early districts the cutting of wheat and oats usually begins in the latter half of the month. Put rams to ewes for breeding early lambs. Spray potato crops.

## AUGUST.

Cut all kinds of grain and pulse as they ripen, and without loss of time, not waiting for them to become dead ripe. Sow rape, turnips, vetches, rye, and barley for winter use. Put rams to ewes, and sell off fat sheep and lambs. Keep wethers well. Watch sows (particularly young ones) near the time of farrowing. Sow grass seeds on old pastures. Transplant lucerne. Weed potatoes by hand, if the horse-hoe cannot reach them. Hand-hoe broadcast turnips for the second time. Sow cabbage seed for "plants" to be transplanted in the coming autumn and spring. Cut lucerne. Run sheep upon seeds that were cut in June. Lay land down to grass. Collect fern, heather, &c., for winter use.

## SEPTEMBER.

Sell off surplus fat stock. Put rams to ewes. Geld pigs farrowed in August. Wean foals. Buy in half-fed sheep and beasts for winter fattening. Manure grass lands. Plough fallows for the last time. Get autumn cultivations as forward as is possible. Cultivate stubbles, and plough land for wheat and other winter crops as far as practicable. Sow winter tares and rye, and upon cold backward soils sow wheat. Turn out swine to feed upon acorns and beech-mast, and put up bacon hogs to fatten. Attend to poultry, and keep them clean. Fatten geese. Examine the books, and balance the accounts of the twelve months now ended.

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If not, it will interest you to know that **an average of  $2\frac{1}{2}$  tons Hay per acre** was grown last year on **TWENTY DIFFERENT FARMS**, on land dressed with

# NITRATE OF SODA

In conjunction with Phosphates and Potash Salts.

Perhaps you do not use Nitrate because you **think** it impoverishes the land. This idea has been proved to be erroneous.

**Judiciously used, Nitrate of Soda improves both the condition and fertility of the Land.**

Nitrate can be **BOUGHT** from all leading Dealers in Manures.

PAMPHLETS, giving full directions, how, when, and in what quantities to apply the Dressings, can be obtained **GRATIS** from

**THE PERMANENT NITRATE COMMITTEE,**  
FRIARS' HOUSE, NEW BROAD STREET, LONDON, E.C.





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